PROJECT MANUAL

BERGEN VALLEY ES ADDITION & RENOVATION

CONFORMED SET

milwaukee : 333 E Chicago St
madison : 309 W Johnson St, Ste 202
green bay : 124 N Broadway
denver : 1899 Wynkoop St, Ste 700
atlanta : 1401 Peachtree St NE, Ste 300

JEFFCO PROJECT NUMBER: **G04600U01**
EUA PROJECT NUMBER: **822808-01**
DATE: **01.08.2024**

PROJECT DIRECTORY

Owner:
Jefferson County School District No. R-1
Construction Management
809 Quail Street, Building #4
Lakewood, Colorado 80215
Phone: (303) 982-2584

Architect:
EUA
1899 Wynkoop St, Suite 700
Denver, CO 80202
Phone: (303) 595-4500

Civil Enginner:
JVA
1319 Spruce Street
Boulder, CO 80302
Phone: (303) 444-1951

Landscape Architect:
Design Concepts CLA, INC
211 N Public Rd
Lafayette, CO 80026
Phone: (303) 664-5301

12/21/23

Structural Engineer:
Martin/Martin
12499 West Colfax Avenue
Lakewood, CO 80215
Phone: (303) 848-8497

Mechanical/Plumbing Engineer:
Envision Mechanical
9777 Pyramid Court, Suite 260
Englewood, CO 80112
Phone: (303) 688-0223

Electrical/Technology Engineer:
AE Design, INC
1900 Wazee Street, #205
Denver, CO 80202
Phone: (303) 296-3034

Acoustics:
DL Adams Associates
1536 Ogden Street
Denver, CO 80218
Phone: (303) 455-1900

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INVITATION TO BID

Bergen Valley Elementary School Addition
Project # F04600A01

EVENT	DATE
Date of Issue	August 1st, 2023
Bid Walk	August 7th, 2023 at 3:00 PM
Question Deadline	**August 14th, 2023 at 2:00 PM**
Addendum Issued	**August 18th, 2023 at 4:00 PM**
Bid Due Date & Time	**August 31st, 2023 at 2:00 PM**

Bids are to be uploaded to BIDNETDIRECT.COM on or before August 31, 2023@ 2:00 PM and will be reviewed by Jefferson County School District R-1 Facilities Planning and Design/Construction Management on August 31, 2023 2:30 PM and will be opened in a Public Microsoft TEAMS Meeting from pre-qualified bidders:

Microsoft Teams meeting

Join on your computer, mobile app or room device
Click here to join the meeting
Meeting ID: 266 571 079 783
Passcode: 3oX5Ht
Download Teams | Join on the web
Join with a video conferencing device
teams@t.jeffco.k12.co.us
Video Conference ID: 113 528 366 8

For: **Project Title: Bergen Valley Elementary School Addition**
Project ID#: F04600A01

Bergen Valley ES
1422 Sugarbush Drive
Evergreen, CO 80439

Bids received after the closing time will be rejected. Immediately after said closing time, all bids received will be publicly opened and read aloud on the Microsoft Teams Meeting in the presence of all interested parties.

Beginning **August 1, 2023**, complete sets of Electronic Contract Documents will be available for download by invitation from **BidNetDirect.Com**

Each bid must be submitted on a form, a specimen copy of which is enclosed in the documents. Do not use Bid Forms bound into the Project Manual. Loose copies of the Bid Form and Bid Bond Forms will be provided for bidders checking out documents. Each bid must be accompanied by a Bid Guaranty in the amount not less than ten (10%) percent of the total bid price in the form of a bid surety bond issued by a company rated not lower than A- in Best's Insurance Guide, latest edition, or have a Best's Financial Rating of at least class X, cashier's check, or certified check drawn on an acceptable bank and payable without qualification to Jefferson County School District R-1. Bid Bonds paid my check shall be dropped off at 809 Quail St Building #4 Construction Management Receptionist prior to the Bid Due date and time.

Bids must be uploaded and marked in a manner prescribed in the contract documents. Jefferson County School District R-1 reserves the right to reject any or all bids, to waive all irregularities, and to accept any bid deemed to be in its best interest.

A mandatory pre-bid meeting for prequalified bidders and interested sub-contractors will be held August 7, 2023 @ 2:30 PM at:

Bergen Valley Elementary School
1422 Sugarbush Drive
Evergreen, CO 80439

Further information will be found in the "Instructions to Bidders" in the Contract Documents.
Dated **07/31/2023**

Questions will be due on **August 14th, 2023 at 2:00 PM** to: Shelley.Lawver@jeffco.k12.co.us

BOARD OF EDUCATION
JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
1829 DENVER WEST DRIVE, BUILDING #27
GOLDEN, COLORADO 80401

INSTRUCTIONS TO BIDDERS

Jefferson County School District No. R-1, State of Colorado, hereinafter called the "Owner", has advertised for bids to be submitted for the construction work specified in the advertisement. Proposals to be entitled to consideration shall be in accordance with the following:

1. EXAMINATION OF SITE and DOCUMENTS

Each Bidder shall visit the site of the proposed work and shall completely inform himself relative to construction hazards, procedure, labor, and all other conditions and factors, local and otherwise, which would affect prosecution and completion of the work and its cost. Such considerations shall include, without limitations, the arrangement and condition of existing structures and facilities; the procedure necessary for maintenance of uninterrupted, safe operation, use and occupancy of existing facilities; the availability and cost of labor; and facilities for transportation, handling and storage of materials and equipment. All such factors shall be properly investigated and considered in the preparation of the bid. Each bidder shall so fully examine the plans and specifications and acquaint himself with their requirements and with the conditions surrounding the construction on the site that he shall be fully familiar with and informed of all facilities, difficulties, and problems associated with or which might be incurred in the prosecution of the work. In case of disagreement between drawings and specifications or within either document itself, the better quality or greater quantity of work shall be figured in the bid (see GC. 6.04). It shall be the responsibility of the Bidder to direct the attention of the Architect and Owner in writing and at least seventy-two (72) hours prior to the time set for the opening of the bids, any seeming inconsistencies, ambiguous requirements, omissions, or any other matter which seems to require explanation, and to request clarification. The submission of a bid shall be taken as prima facie evidence of compliance with this requirement and as an acknowledgment that the Bidder has received all the required documents and has visited the site. There will be no subsequent financial adjustment for lack of such prior information.

2. INTERPRETATION

No oral interpretations will be made by anyone to any Bidder as to the true meaning or requirements of any part of the drawings, specifications or other proposed Contract Documents. Every request for an interpretation shall be made in writing and addressed and forwarded to the Architect and the Owner not later than seventy-two (72) hours before the date fixed for opening of bids. The person submitting the request shall be responsible for its prompt delivery. Every interpretation made to a Bidder will be in the form of an addendum to the Contract Documents, which, if issued, will be sent as promptly as is practicable to all persons to whom the drawings, specifications, and other proposed Contract Documents have been issued. All such addenda shall become part of the Contract Documents and their receipt shall be acknowledged in the Bid Proposal. The Owner will not be responsible for any other explanations or interpretations of the proposed Contract Documents.

3. BID FORMS

Bid forms will be supplied by the Owner. Proposals shall be made upon the forms provided therefor.

Attention is directed to the fact that the Contract Documents contain one complete set of bidding and contract forms; these are sample forms included for the information of Bidders. They are not to be detached from the Contract Documents, filled out or executed.

Special attention is directed to the Form of Bid Bond included in the bidding documents. Additional copies of this form may be secured from the Architect, but the use of this particular form is not mandatory. Any similar standard form of a recognized responsible surety which contains the same stipulations and guarantees, the same execution of the contract and indemnification of the Owner in case of default, will be acceptable.

4. PREPARATION OF BID FORMS

All proposal forms must be prepared in single copy and in conformity with and be based upon and submitted subject to all requirements of the Contract Documents. They must be fully completed with all blanks appropriately filled in. Each bid shall be legibly written or printed in ink on the separate form provided. No alterations in bids, or in the printed forms therefor, by erasures, interpolations, or otherwise will be acceptable unless each such alteration is signed or initialed by the Bidder; if initialed, the Owner may require the Bidder to identify any alteration so initialed. No alteration in any bid, or in the form on which it is submitted, shall be made after the bid has been submitted.

It will be the Bidder's responsibility to secure any and all addenda from the Architect. The Bidder will be required to acknowledge receipt of all addenda. Owner reserves the right to reject any bid which is received which has not been based upon all addenda issued by the Architect.

No Bidder may submit more than one bid. Multiple bids under different names will not be accepted from one firm or association.

The Bidder is required to bid on all alternates and complete all blanks on the bid form. If alternates are called for on a type or method of construction as to which the Bidder does not desire to bid, he shall insert the words "NO BID". In case the Bidder desires to bid on an alternate, he shall set forth in the space provided therefor, the amount to be added or deducted from the base bid or in the event that the Bidder does not desire to make a change from the base bid, he shall so indicate by using the words "NO CHANGE". In the selection of alternates, the Owner reserves the right to select or reject any or all alternates in the proposal if, in the judgment of the Board of Education, or its designees, the best interest of the School District will be so served.

5. BID PERFORMANCE GUARANTIES

Bid security (single copy) in the form of a cashier's check drawn on an acceptable bank or bid bond in the amount of at least ten (10%) percent of the bid price, payable without condition or qualification to Jefferson County School District No. R-1, shall accompany each bid, as evidence of good faith and as a guarantee that if awarded the contract, the Bidder will execute the Contract and give bond as required. The Bidder assumes all responsibility for furnishing acceptable bid security.

Bid security in the form of a bond will be accepted only if from a regularly established firm licensed to write such surety in the State of Colorado and which is rated not lower than A- in Best's Insurance Guide, latest edition, or have a Best's Financial Rating of X.

The bid security of each unsuccessful Bidder will be returned when the Construction Agreement is fully executed. The bid security will be voided but retained by the Owner, if, after the Notice of Contract Award, the Bidder shall enter into a Contract and file a satisfactory performance bond, labor and material payment bond, and certificates of required insurance, all within ten (10) calendar days after the date such notice is given by the Owner. The bid security of the second and third lowest responsible Bidders may be retained for not to exceed forty-five (45) days after opening, pending the execution of the Construction Agreement and submission of bond by the successful Bidder.

This bid security may be retained by the Owner as liquidated damages, if the bid is accepted and a contract thereon is awarded but the successful Bidder fails to enter into a contract in the form prescribed with legally responsible sureties, within ten (10) calendar days after date of Notice of Contract Award is given by the Owner.

The Owner shall require the Bidder to whom a Contract is awarded to furnish to the Owner both Performance and Labor and Material Payment bonds in the amount of one hundred (100%) percent of the Contract price, covering the faithful performance of the Contract and the payment of all obligations arising thereunder, and the Bidder will further provide warranties as required by the specifications or General Conditions.

The bonds shall be executed on the forms included with the Contract Documents (forms shall not be removed from the Contract Documents; Bidders shall obtain original copies of the bond forms from the Owner). Accompanying each bond form shall be a "Power of Attorney" authorizing the attorney in fact to bind the surety company and certified to include the date of the bond.

6. LIST OF SUBCONTRACTORS

The low three (3) bidders shall within twenty-four (24) hours following the bid opening notify the Owner in writing of the entire list of subcontractors and suppliers of labor and material whose quotations he has used in preparation of his bid and whose services he proposes to use in construction of the project. The list must be complete showing all sections in the Construction Documents. Failure to submit such a list may preclude the bid from further consideration by the Owner. The Owner reserves the right to either disclose or not disclose the subcontractor list of the successful Bidder.

Each Bidder shall identify and fully disclose on such list all those subcontractors and suppliers proposed for the work with which the Bidder is connected either directly or indirectly as part owner, participant in profits and losses or in any other manner financially or economically.

7. PERMITS AND FEES

Each contractor shall secure and pay for the legal permits and inspection fees required for the execution of his work. The Owner is exempt from paying certain fees and it will be the contractor's responsibility to acquaint himself with the laws and regulations governing said fees. Attention is directed to the requirements of the General Conditions regarding obtaining permits.

8. TAXES

The Owner is exempt from the collection and payment of state sales and use taxes on any materials, supplies or other equipment used or installed in the work. Some cities and municipalities may charge a local sales or use tax for materials, supplies or equipment picked up by the contractor in that city or municipality for use at a job site outside of that city or municipality. In such cases the contractor, subcontractors and suppliers should have all building materials, supplies and equipment delivered to the job site by common carrier, by conveyance of the seller or by mail in order to be exempt from the local sales or use taxes. The contractor's bid proposal and any agreed upon variations thereof shall include the cost of any such taxes. For state sales and use taxes, it shall be the responsibility of the contractor and each subcontractor to complete and file an "Application for Exemption Certificate" with the Colorado Department of Revenue and submit copies of such Certificate to the Owner upon award of the contract and prior to commencing any work.

9. PREFERENCE FOR LOCAL MATERIALS, LABOR AND RESIDENT BIDDERS

Preference is hereby given to materials, supplies and provisions produced, manufactured or grown in Colorado, quality being equal to articles offered by competitors outside of the state. Each contractor shall comply with the provisions of Colorado Revised Statutes, Sections 8-17-101 and 102, and 8-18-101 and 103 (as amended) giving preference to Colorado labor and materials in the performance of the work.

Preference shall also be given to resident bidders in accordance with provisions of Colorado Revised Statutes, Section 8-19-101 and 102 (1985).

10. SIGNATURE OF BIDDERS

Each Bidder shall sign the bid form and bid bond using his usual signature and giving his full business address. If the Bidder is an individual, he must sign in individual capacity. Bids by partnerships shall be signed with the partnership name followed by the signature and designation of one of the partners or other authorized representative. Bids by corporations shall be signed with the name of the corporation followed by the signature and designation of the president or other person authorized to bind the corporation and attested to by the secretary with corporate seal. Bids by joint ventures shall be signed by each participant in the joint venture or by an authorized agent of each participant. The names of all persons signing should also be typed or printed below the signature.

A bid by a person who affixes to his signature the word "president", "secretary", "agent", or other designation without disclosing his principal may be held to be the bid of the individual signing. When requested by the Owner, evidence of the authority of the person signing shall be furnished.

11. SUBMISSION OF BIDS

Bid Documents shall be enclosed in two envelopes (outer and inner), or one opaque envelope, each of which shall be sealed and clearly labeled "BID DOCUMENTS" and identified with the description of the work to which the proposal applies; the name of the project; the name and address of the Bidder; and the time of opening bids; all in prominent lettering so as to guard against opening prior to the stipulated time. No responsibility shall attach to any employee of the Owner for the premature opening of any bid not prominently identified. The Bidder shall be responsible for placing his firm name and the name and number, if applicable, of the project and the time of the bidding on the outside of such bid envelope.

The Bid Documents shall be submitted at the time and location as noted in the Invitation to Bid. Bids received after the specified time of closing will be returned unopened.

12. WITHDRAWAL OF BIDS

Any Bidder may withdraw his bid if written request for withdrawal signed in the same manner and by the same person who signed the Bid Form is received by the individual of the School District requesting the bids prior to the time established for the opening of the bids.

No Bidder may withdraw his bid for forty-five (45) days after the scheduled time set for the opening thereof, or before award of the Contract, unless said award is delayed for a period exceeding forty-five (45) calendar days.

13. MODIFICATIONS

No oral, telephonic, or telegraphic modifications will be considered.

14. ACCEPTANCE OF BIDS

The Owner reserves the right to accept the bid which in its judgment is the most responsible and best bid or to reject any and all bids and alternatives and to waive or disregard irregularities or informalities in any bid as it may deem to be in the best interest of the School District. The Board of Education or its designees may consider as irregular any bid on which there is an alteration of, or departure from, the bid form. All proposals received after the specified time of closing shall be returned unopened.

Final determination of compliance with specifications will rest with the Owner.

15. TIME OF COMPLETION

It is to be understood that time is of the essence for this Contract and the contractor will be required to perform the work within the allowable time set forth in the Contract. In this connection, attention is directed to the provisions of the General Conditions and Supplementary General Conditions, if any, relative to delays, extensions of time, and liquidated damages. The successful Bidder-contractor shall prepare and submit for the Owner's approval, within ten (10) days after the Notice of Award, a Preliminary Construction Schedule or Schedules that will indicate the time of performance and completion of the various portions of the work and the dates on which the Owner may expect to be allowed to occupy portions of the building. A Detailed Construction Schedule shall be submitted by the Contractor prior to the submission of the first request for payment. No partial payment on account of work performed shall be made until such Detailed Construction Schedule has been approved by the Owner.

The Owner and the Contractor shall agree mutually on any changes in either the schedule or the rate of performance of the work which might either favorably or adversely affect such schedule dates. Unless otherwise specifically agreed in writing, no additional compensation or fee shall be paid by the Owner for any completion of all or any portions of the work earlier than scheduled.

16. APPLICABLE LAWS AND REGULATIONS

Each Bidder shall familiarize himself with all state and local laws, codes, ordinances, and regulations which might in any manner affect the work to be done; the materials to be supplied; the taxes, permits and fees to be paid; or the labor to be employed in and about the work. Any claim of misunderstanding or ignorance on the part of any successful Bidder will not in any way excuse such Bidder from the necessity of full compliance with every such law, code, ordinance, or regulation. All state laws, codes and regulations and local ordinances, which are applicable, shall be complied with including but not limited to those specified in these documents.

17. EVIDENCE OF COMPETENCY

Bidders shall submit within three (3) days, if requested by the Owner such evidence of the Bidder's competency and practical knowledge to do the particular work covered by his proposal and of the Bidder's financial responsibility, resources, experience, organization and equipment to complete the proposed work. Failure to comply with this requirement may result in the rejection of

consideration of such bid. The right is reserved to reject any bid where an investigation of the evidence or information submitted by such Bidder does not demonstrate fully that the Bidder is qualified to properly carry out the terms of the contract.

In determining the Bidder's qualifications, the following factors, among others, will be considered: work previously completed by the Bidder; the qualifications of the proposed subcontractors for their work; Bidder references; and whether the Bidder (a) maintains a permanent place of business; (b) has adequate plant and equipment to do the work properly and expeditiously; (c) has the financial resources to meet all obligations incident to the work; (d) has appropriate technical experience; and (e) has adequate, competent, experienced staff and supervisors who will be committed to the work until completion.

Each Bidder may be required to show that he has handled former work and that no just claims have been prosecuted or are pending against such work. No bid will be accepted from a Bidder who is engaged on any work which would impair his ability to perform or finance this work or other work in progress.

18. INSURANCE

Throughout the life of the contract, the Contractor will be required to carry the types and amounts of insurance named in the General Conditions.

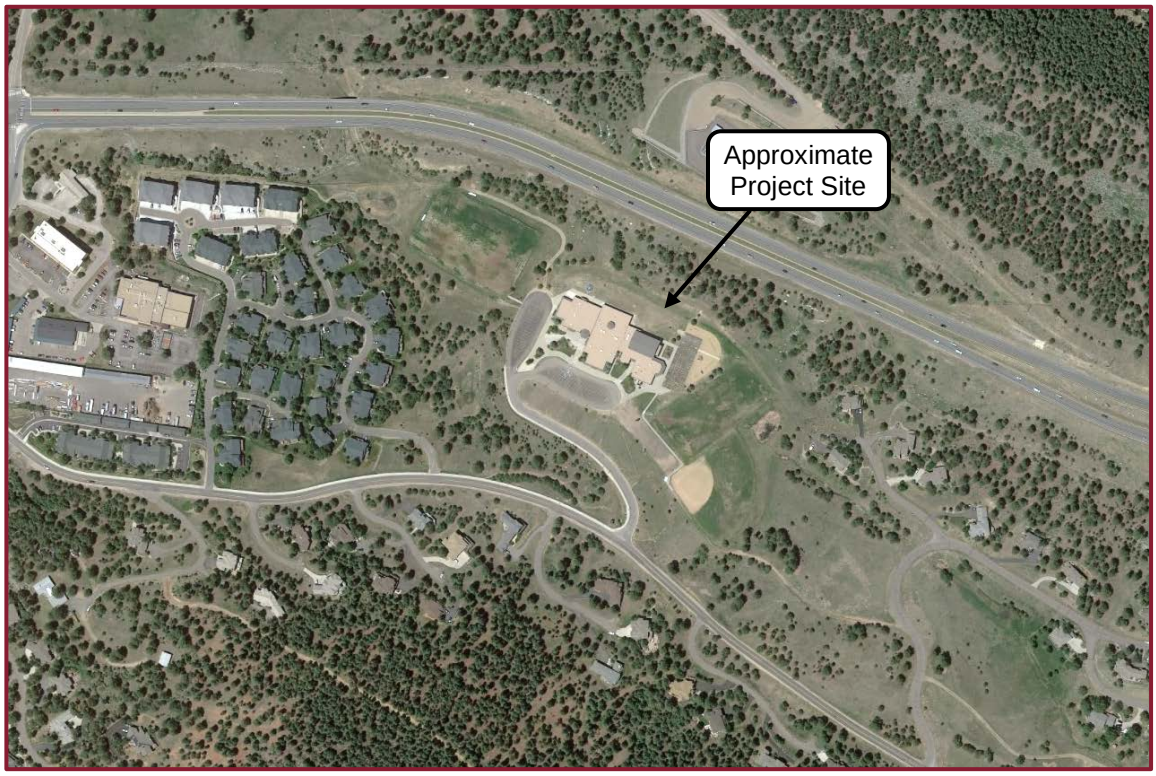
19. CONTRACTOR'S LICENSE

Any successful Bidder may be required by the Owner to obtain the necessary and applicable Contractor's License from all appropriate governmental authorities and if required, shall not allow any subcontractor to commence work on his subcontract until all similar provisions required of the subcontractor have been obtained and approved.

END OF INSTRUCTIONS TO BIDDERS

GROUND
ENGINEERING

Geotechnical Evaluation
Bergen Valley Elementary School
Additions and Facility Access Improvements
Evergreen, Colorado
Revision 1



Prepared For:
Jeffco Public Schools
809 Quail Street, Building #4
Lakewood, Colorado 80215

Attention: Mr. Ted Hagan

Job Number: 22-3677A **June 2, 2023**

41 Inverness Drive East | Englewood, CO 80112 | (303) 289-1989 | www.groundeng.com
ENGLEWOOD | COMMERCE CITY | LOVELAND | GRANBY | GYPSUM | COLORADO SPRINGS

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Gradation Testing Results....Appendix B

PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) for Jeffco Public Schools in support of design of the proposed additions and facility access improvements to the Bergen Valley Elementary School facility located at 1422 Sugarbush Drive in Evergreen, Colorado. Our study was conducted in general accordance with GROUND's Proposal No. 2212-2259, dated December 14, 2022, GROUND's Change Order Request dated January 23, 2023, and the associated agreement and purchase order.

A field exploration program was conducted to obtain information on the subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the engineering characteristics of the site soils and bedrock. The results of the field exploration and laboratory testing are presented herein.

This report has been prepared to summarize the data obtained and to present our findings and conclusions based on the proposed developments and the subsurface conditions encountered. Design parameters and a discussion of engineering considerations related to the proposed improvements are included herein. This report should be understood and utilized in its entirety; specific sections of the text, drawings, graphs, tables, and other information contained within this report are intended to be understood in the context of the entire report. This includes the *Closure* section of the report which outlines important limitations on the information contained herein.

This report was prepared for design purposes of Jeffco Public Schools based on our understanding of the proposed project at the time of preparation of this report. The data, conclusions, opinions, and geotechnical parameters provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore, the information provided in this report was based on the exploration and testing methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases those deviations may be significant.

A conference call was held on February 22nd, 2023, with the Client and members of the Project Team, shortly after completion of the subsurface exploration, to discuss

preliminary geotechnical considerations for design. Additionally, current project designs and performance history of the facility were discussed.

On May 25th, 2023, GROUND was contacted by the Project Architect and provided with updated project information. We understand the second story of the proposed classroom was eliminated which resulted in a reduction in the anticipated maximum column and wall loading to 100 kips and 2 klf, respectively. The classroom addition expanded by approximately 2,000 square feet to an approximate footprint area of 14,000 square feet. The cafeteria addition decreased by approximately 600 square feet to an approximate footprint area of 700 square feet. No updated/revised plans were provided to GROUND at the time of this revised report preparation.

Additionally, the Project Structural Engineer proposed an alternative remedial fill prism/over-excavation approach for the proposed classroom addition. Subsequent correspondence from Jeffco Public Schools indicated they desired to pursue this approach. This approach is discussed further in later sections of this report.

PROPOSED CONSTRUCTION

The following project documents and information were provided to GROUND by the Client and Project Team for development of the parameters and considerations in this report:

- **Original Geotechnical Report for Facility and Associated Addendum Letter –** *Bergen Valley ES_Geotech Report_1995.pdf.* Geotechnical Engineering Study, Elementary School No. 13, Bergen Park, Jefferson County, Colorado. Prepared by Goodson & Associates, Inc. Dated November 2, 1995. Geotechnical Report Addendum Prepared by Goodson & Associates, Inc. Dated November 20, 1995.
- **Historical Site Survey –** *Bergen Valley ES – Original Survey.pdf*. Topographic Survey of Elementary School #13, A Part of Sections 20 & 21, Township 4 South, Range 71 West, 6th P.M., County of Jefferson, State of Colorado. Prepared by Benchmark Surveying Ltd. Dated September 21, 1995.
- **Historical Site Survey –** *Bergen Valley ES – Original Grading.pdf*. Grading and Drainage Plan, Bergen Valley Elementary School, Evergreen, Colorado, Jefferson County School District R-1. As-Builts. Dated September 8, 1997. Prepared by Benchmark Surveying Ltd. Dated September 21, 1995.

- **Design Development Submittal Plans -** *F04600U21_BergenValleyES Addition_DD-Dwgs_02-17-2023.pdf.* Jefferson County School District, R-1, Bergen Elementary School Addition and Renovation, Design Development Submittal. Dated February 17, 2023.
- **Martin/Martin Subsurface Letter –** *BergenValleyESAddition_SubsurfaceLtr_20221201.pdf.* JCSD Bergen Valley ES Classroom and Cafeteria Addition, Martin/Martin Project No.: 22.1668.S.01. Dated December 1, 2023.
- **Markup of Foundation Plans by Structural Engineer** – *2023-02-23 – BVES geotech markups.pdf.* Foundation and Roof Plan – Area B, Foundation Plan – Area C, Level 2 Plan – Area C (Sheet S101B, S101C, and S102C). Dated February 23, 2023.

Based on provided plans and information, we understand an approximate 14,000 square-foot, single-story classroom addition is planned for the northern side of the school building. Additionally, an approximate 700 square-foot, single-story cafeteria addition is planned for the eastern side of the building. No below grade levels are planned. Based on provided information, we understand maximum column loads are anticipated to be on the order of approximately 100 kips and maximum wall loads are anticipated to be on the order of approximately 2 kips per foot. Based on a discussion with the Project Structural Engineer and a provided marked up site plan, we understand imposition of new loads to existing building foundations is planned as part of the additions and renovations.

A finish floor elevation (FFE) of approximately 7,711.17 feet is planned for the lowest level of the proposed classroom addition. Earthen cuts ranging up to approximately 4 feet are anticipated to be necessary to facilitate the proposed classroom addition grade. Additionally, an existing water line located within near the northern margin of the proposed addition footprint will be removed.

Although a FFE was not indicated for the proposed cafeteria addition, we assume an FFE of approximately 7,711 feet is planned. Earthen fills ranging up to approximately 3 feet are anticipated to be necessary to facilitate the anticipated cafeteria addition grade.

The paved parking area south of the building will be expanded to the south of its existing southern margin and cut into the existing north-sloping hillside. A retaining wall is planned for the toe of the hillside, south of the expanded parking area. Elevations for the proposed retaining wall alignment were unavailable at the time of this report preparation. We

assume a wall height on the order of approximately 5 feet is planned and that the wall will be constructed in a cut condition.

A new entry drive is also planned for the facility. The entry drive will extend north from Sugarbush Drive (near its intersection with Alyeska Court) and then continue northwest to the eastern margin of the existing drop-off loop south of the school. The new entry drive will be approximately 730 linear feet in length. Based on correspondence from the Project Civil Engineer, we understand retaining walls are preliminary anticipated to support grade changes along the proposed entry drive. A strip of street-side-type parking is also planned along the entry drive, nearer to the school building. Earthen cuts and fills on the order of approximately 5 feet are anticipated to facilitate proposed entry drive grades. Elevations and locations of the proposed entry drive retaining wall alignments were unavailable at the time of this report preparation. We assume wall heights on the order of approximately 5 feet are planned and that the wall will be constructed in both cut and fill conditions.

Based on the conference call on February 22nd, 2023, we understand mechanically stabilized earth (MSE) walls are planned as the retaining wall system for all proposed site retaining walls.

New pedestrian exterior flatwork and buried utilities are also anticipated.

The project site is shown in Figure 1. **If our described understanding/interpretation of the proposed project is incorrect or project elements differ in any way from that expressed above, including changes to improvement locations, dimensions, orientations, loading conditions, elevations/grades, etc., and/or additional buildings/structures/site improvements are incorporated into this project, either after the original information was provided to us or after the date of this report, GROUND or another geotechnical engineer must be retained to re-evaluate the conclusions and parameters presented herein.**

Performance Expectations Based on our experience with other, similar projects, we assume that post-construction, building foundation and floor movements on the order of 1 inch are acceptable to, and anticipated by the owner, as are the resultant distress and maintenance measures. Similarly, we anticipate that movements of somewhat greater magnitude (2 to 3 inches) are acceptable and anticipated for pavements flatwork, although movement estimates closer to 1 inch may be preferable near the building. Assuming that

traffic speeds will be relatively low, still greater movements (3+ inches locally) are acceptable and anticipated for the pavements, as well as for flatwork that is not adjacent to the buildings. GROUND will be available to discuss the risks and remedial approaches outlined in this report, as well as other potential approaches, upon request if post-construction movements of these magnitudes are not acceptable and anticipated.

SITE CONDITIONS

At the time of our exploration, the majority of unimproved surfaces at the site were covered in variable thicknesses of snow. Therefore, it should be understood that observations of surface conditions and features were very limited. The project site consisted of the existing Bergen Valley Elementary School facility. The facility was situated on a bench within a valley located between Sugarbush Drive to the south and Evergreen Parkway to the north. Undeveloped, semi-forested land and residential developments bordered the site to the east and west.

The existing school building consisted of a single-story building with a masonry exterior. Concrete flatwork wrapped the perimeter of the building and an asphalt entry drive, drive lanes, and parking area were located south and west of the building. A concrete sidewalk was noted west and south of the western and southern margins of the entry drive. An asphalt playcourt and pea-gravel playground area were located east of the building. A relatively small, greenhouse dome structure was located north of the building, near the proposed classroom addition. An aggregate/road base service drive connected the eastern margin of the paved drive loop south of the school to a baseball diamond to the southeast. A concrete sidewalk was located north of the service drive and connected the baseball diamond to the concrete flatwork east of the building (near the playcourt/playground areas).

Based on our cursory review of available Google Earth aerial imagery of the site, irrigated turf grasses appear to be associated with the athletic fields, baseball outfield, and

landscaping areas at the site. Deciduous and evergreen trees were also scattered across the site and were comparatively denser within the southern portion of the proposed entry drive alignment. Boulders were also noted locally at various locations at the site.

Surrounding grades generally descended inward toward the school facility from the south, west, and north. Grades generally descended steeply to the north and northeast from Sugarbush Drive and up to approximately 70 feet of relief was exhibited between Sugar Bush Drive and the approximate building grade. Grades descended moderately to steeply to the south from Evergreen Parkway and up to approximately 40 feet of relief was exhibited between Evergreen Parkway and the approximate building grade. Grades also generally descended moderately to steeply to the east from the areas west of the site. Grades generally descended gently to moderately to the east and northeast within the playcourt/playground and athletic field areas before descending moderately to steeply to the east. A detention pond was located southeast of the school building, to the northeast of leftfield within the baseball diamond.

Descriptions of the condition of the site prior to construction of the facility were made in the original geotechnical (prepared by others). Based on this report, we understand that a fill pad, with thicknesses ranging from approximately 10 to 20 feet, was constructed on the valley floor at the site using sands, gravels, cobbles, and boulders obtained from excavations associated with the then recently re-aligned Evergreen Parkway. The report's authors also anticipated the building would be constructed over approximately 5 to 10 feet of fill which had not been placed at the time of the report's preparation.

Fill materials were encountered in the test hole at the time of drilling. Greater thicknesses of man-made fill may exist at the site due to previous earthwork operations and the existing building construction. Delineation of the complete lateral and vertical extents of any fills at the site or their compositions, however, was beyond our present scope of services. If fill

soil volumes and compositions at the site are of significance, they should be further evaluated using test pits.

SUBSURFACE EXPLORATION

The subsurface exploration for the project was conducted on January 31st and February 20th, 2023. A total of eight (8) test holes were drilled at the site with buggy- and track-mounted, continuous flight power auger rigs advancing 4-inch solid-stem augers to evaluate the subsurface conditions as well as to retrieve soil and bedrock samples for laboratory testing and analysis. The approximate locations of Test Holes 1, 2, 3, RW-1, and PP-3 were suggested by Martin/Martin in their subsurface letter. Test Holes 1, RW-1, and PP-3 were shifted in the field by GROUND due to buried utility and/or access constraints. The locations of Test Holes PP-1, PP-2, and PP-4 were determined by GROUND based on preliminary site layout plans.

Two (2) test holes were drilled within the proposed classroom addition footprint, one (1) test hole was drilled within the proposed cafeteria addition footprint, one (1) test hole was drilled near the proposed retaining wall alignment located south of the school, and four (4) test holes were drilled within/adjacent to the proposed access drive alignment. The building foundation test holes were drilled to depths of approximately 29 to 40 feet below existing grades and the remaining test holes were drilled to depths of approximately 4 to 19 feet below existing grades.

Practical auger drill rig refusal was encountered in Test Holes PP-3 and PP-4 at depths of approximately 6 and 14 feet below existing grades, respectively. Test Hole PP-3 was offset approximately 5 feet from its initial location and was advanced in the offset location to its target depth. The test hole log for PP-3 has been drafted to depict the maximum exploration depth in the offset location.

GROUND directed the subsurface exploration, logged the test holes in the field, and prepared the soil and bedrock samples for transport to our laboratory.

Samples of the subsurface materials were retrieved with a 2-inch I.D. California liner sampler and a 1⅜-inch I.D. standard penetration test sampler. The samplers were driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586.

Penetration resistance values, when properly evaluated, indicate the relative density or consistency of soils. Depths at which the samples were obtained and associated penetration resistance values are shown on the test hole logs. A composite bulk sample was also obtained from test holes RW-1, PP-1, PP-2, and PP-3.

The approximate locations of the test holes are shown in Figure 1. Logs of the exploratory test holes are presented in Figure 2 and Figure 3. Explanatory notes and a legend are provided in Figure 4. Detailed logs of the test holes are presented in Appendix A. GROUND utilized the Client-provided site plan indicating existing features, Google Map imagery and a hand-held GPS to approximately locate the test holes. The elevations of the test holes were estimated from Client-provided documents depicting existing site grades.

LABORATORY TESTING

Samples retrieved from our test holes were examined and visually classified in the laboratory by the project engineer. Laboratory testing of soil and bedrock samples obtained from the subject site included standard property tests, such as natural moisture contents, dry unit weights, grain size analyses, and Atterberg limits. Swell-consolidation, unconfined compressive strength, water-soluble sulfates, and corrosivity testing were also performed on selected samples. Laboratory tests were performed in general accordance with applicable ASTM and AASHTO protocols. Results of the laboratory testing program are summarized in Tables 1 and 2 and Appendix A.

SUBSURFACE CONDITIONS

Geologic Setting Published geologic maps (Douglas, Reed, Bryant, 1972[1]) depict the project area as underlain by Upper Holocene Piney Creek Alluvium (**Qp**) and Precambrian Interlayered Hornblende Gneiss, Calc-Silicate Gneiss, and Amphibolite (**hcs**). The alluvial deposits are generally described to consist of humic silts and sands with gravels. The gneiss and amphibolite are generally described to consist of fine- to medium-grained gneisses and variably foliated amphibolite.

[1] Sheridan, Douglas. M., Reed, John. C., Byrant, Bruce (1972). *Geologic Map of the Evergreen Quadrangle, Jefferson County, Colorado*. United States Geological Survey.

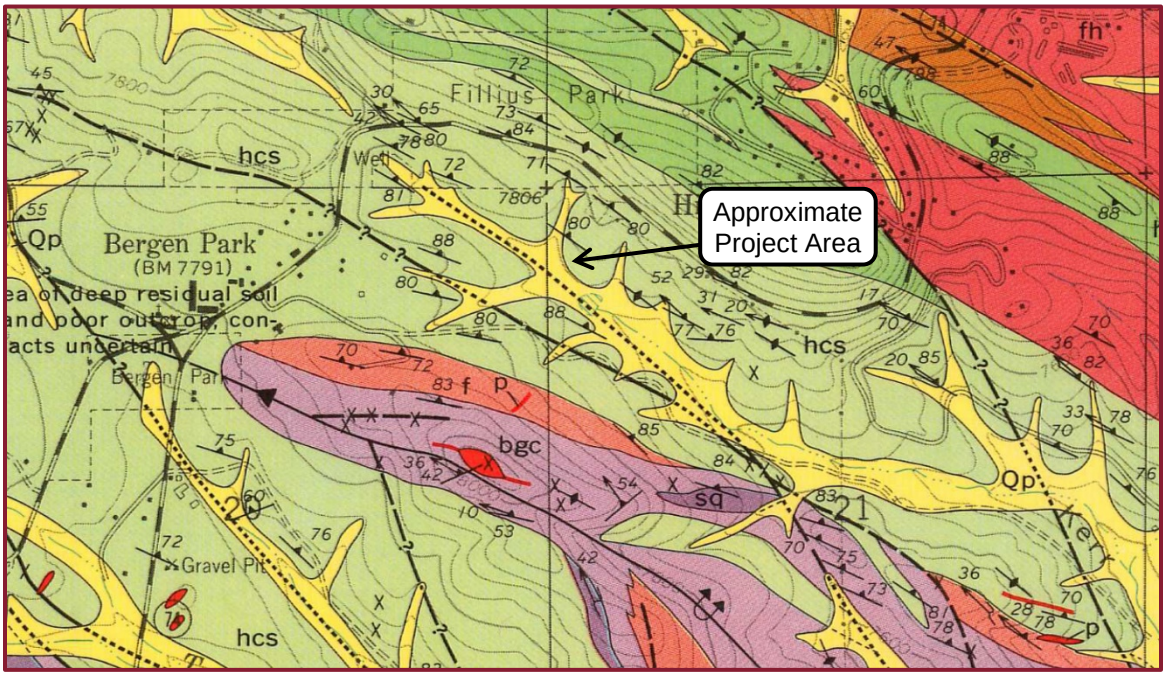
In the project area, alluvial (steam-laid) deposits typically consist of fine to coarse sands, gravels, cobbles, and boulders with local silts and clays. The larger clasts (cobbles and boulders) may be awkward or difficult to handle and may not be appropriate for use in all fills.

Gneiss is a heavily metamorphosed (deformed) rock characterized by foliation and mafic/felsic banding. The banding can be on various scales, ¼ inch or smaller to several feet or more. The foliations can create planes of weakness where relatively weaker minerals are layered together in a preferential orientation.

Amphibolite is a coarse-grained metamorphic rock.

Depending on several factors, including the level of weathering, minerology, deformation (i.e., jointing, fracturing, etc.), bedrock may require significant efforts to excavate and, in some cases, require blasting, hammering, and/or other hard rock excavation techniques to excavate.

For simplicity, this report will refer to the local bedrock as gneiss, although not all of the bedrock will meet the geologic definition of gneiss. A portion of the above-referenced map is reproduced below.



Local Subsurface Conditions The subsurface conditions encountered in the test holes generally consisted of approximately 2 to 3 inches of topsoil[2] (encountered in Test Holes 1, 2, PP-2, PP-3, and PP-4) or approximately 5 inches of asphalt[3] (encountered in Test Hole RW-1) or approximately 4 inches of concrete[3] (encountered in Test Hole 3) or approximately 4 inches of road base (encountered in Test Holes PP-1). These surficial materials were underlain by FILL materials that extended to depths ranging up to approximately 7 feet below existing grades in the majority of the test holes and to a depth of approximately 22 feet below existing grade in the cafeteria addition footprint. The FILL materials were underlain by silty to clayey SANDS with gravels that extended to depths of approximately 3 to 37 feet below existing grades (depths of approximately 24 to 31 feet below existing grades in Test Holes 1 and 2, a depth of approximately 37 feet below existing grade in Test Hole 3, a depth of approximately 14 feet below existing grade in Test Hole RW-1, and depths ranging from approximately 3 to 10 feet below existing grade in Test Holes PP-1 through PP-4). The silty to clayey SANDS with gravels were underlain by GNEISS bedrock that extended to the depths explored.

It should be noted that coarse gravel, cobbles, and boulders are not well represented in samples obtained from small diameter test holes. At this site, therefore, it should be anticipated that gravels and cobbles, and possible boulders, may be present in the man-made fill and native soils, even where not included in the general descriptions of the site soil types below. Material sizes and descriptions are largely interpreted based on drilling advancement rates and other observations during drilling operations. Additional exploration utilizing alternate methods, such as test pits, should be considered if more information is desired.

FILLS generally consisted of silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.

Delineation of the complete lateral and vertical extents of any fills at the site, or their composition, however, was beyond our present scope of services. If fill soil volumes and

[2]'Topsoil' as used herein is defined geotechnically. The materials so described may or may not be suitable for landscaping or as a growth medium for such plantings as may be proposed for the project.
[3]Pavement thicknesses are difficult to determine with precision in small diameter test holes. If existing pavement thicknesses are of significance to the project, then additional, larger diameter test holes or pavement cores should be drilled.

compositions at the site are of significance, they should be further evaluated using test pits.

Silty to Clayey SANDS with Gravels generally consisted of silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.

GNEISS Bedrock generally consisted of fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.

Groundwater was encountered in Test Hole 1 at a depth of approximately 35 feet below existing grade at the time of drilling. The test holes were backfilled upon completion of site drilling operations per Code of Colorado Regulations (2 CCR 402-2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not constitute a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND should be contacted; additional exploration and fees will be necessary in this regard.

It has been our experience that surface and groundwater levels fluctuate greatly in mountainous areas, primarily due to seasonal conditions such as spring runoff. These conditions are often highly variable and difficult to predict. Although these conditions generally exist for a few months annually, their impact on design can be significant. In the project area, it is common during construction to encounter dry conditions in the fall and wet conditions in the spring with relative groundwater fluctuations of 10 feet or more. This is particularly critical for foundation and deep utility excavations, cut slopes, culvert sizing, and for development adjacent to intermittently dry streams, rivers, and wetlands.

Swell-Consolidation Testing of samples of the site earth materials encountered in the project test holes indicated a relatively low potential consolidation. A consolidation of approximately 0.3 percent was measured under a surcharge load approximating the in-place overburden pressures. Swell-consolidation testing results are presented on Table 1 and Appendix A.

ENGINEERING SEISMICITY

Based on extrapolation of available data to depth and our experience in the project area, we consider the site likely to meet the criteria for a Seismic Site Classification of D according to ASCE 7-16 (Table 20.3-1). Actual shear wave velocity testing/analysis and/or exploration to 100 feet was not performed. If, however, a quantitative assessment of the site seismic properties is desired, then shear wave velocity testing should be performed. GROUND can provide a fee estimate for shear wave velocity testing upon request.

Utilizing the web-based ASCE 7 Hazard Tool (https://asce7hazardtool.online) and site latitude and longitude coordinates of 39.692533°N and 105.349637°W (obtained from Google Earth), respectively, the project area is indicated to possess an S_{DS} value of 0.275 and an S_{D1} value of 0.104.

GEOTECHNICAL CONSIDERATIONS FOR DESIGN

The conclusions and parameters provided in this report were based on the data presented herein, our experience in the general project area with similar structures, and our engineering judgment with regard to the applicability of the data and methods of forecasting future performance. A variety of engineering parameters were considered as indicators of potential future soil movements. Our parameters and conclusions were based on our judgment of "likely movement potentials," (i.e., the amount of movement likely to be realized if site drainage is generally effective, estimated to a reasonable degree of engineering certainty) as well as our assumptions about Jeffco Public Schools willingness to accept geotechnical risk. "Maximum possible" movement estimates necessarily will be larger than those presented herein. They also have a significantly lower likelihood of being realized in our opinion, and generally require more expensive measures to address. We encourage Jeffco Public Schools upon receipt of this report, to discuss these risks and the geotechnical alternatives with us.

In addition to the risks and remedial approaches presented, Jeffco Public Schools, also must understand the risk-cost trade-offs addressed by the civil and structural engineering disciplines in order to direct their design team to the portion of the Higher Cost / Lower Risk – Lower Cost / Higher Risk spectrum in which this project should be designed. If Jeffco Public Schools does not understand these risks, it is critical that additional information or clarification be requested so that Jeffco Public Schools' expectations reasonably can be met.

Depth of Wetting at the Site The "depth of wetting" (the depth to which foundation soils will gain moisture and experience volume change over the design-life of a structure) estimated for a given site strongly affects the anticipated performance of structures at that site. Based on the data obtained at this site and our experience with similar geotechnical settings, a 'depth of wetting' of 20 feet was used to develop geotechnical parameters for foundation system design. A depth of wetting of 20 feet is equal to or greater than the depth of wetting found at about 72 percent of the sites evaluated in a study by Walsh and others (2009).[4]

'Depths of wetting' of 30, 40 or 70 feet or more have been considered (e.g., Chao and others, 2006)[5] and have been encountered locally in the field. Depths of wetting of such magnitudes, however, generally are in unusual geologic conditions or identified forensically in unusual circumstances such as a pipe leak that has remained un-repaired for an extended period. In our experience, such deep 'depths of wetting' are considered only rarely in engineering consulting practice in more typical geologic settings in the Colorado Front Range area.

GROUND considers a 20-foot depth of wetting to be appropriately conservative for the proposed project. However, if the owner prefers that a more conservative (or less conservative) 'depth of wetting' be used to develop geotechnical parameters for design, GROUND should be contacted to revise the criteria provided herein.

Geotechnical Risk In GROUND's opinion there are several sources of geotechnical risk at the site. As previously discussed, fill soils were observed in the test holes which

[4] Walsh, K.D., C.A. Colby, W.N. Houston, and S.A. Houston, 2009, *Method for Evaluation of Depth of Wetting in Residential Areas*, Journal of Geotechnical and Geoenvironmental Engineering, American Society of Civil Engineers, Vol. 135, No. 2, pp. 169 – 176.

[5] Chao, K-C, D.D. Overton, and J.D. Miller, 2006, *The Effects of Site Conditions on the Predicted Time Rate of Heave*, Unsaturated Soils 2006, American Society of Civil Engineers, Special Publication No. 147, pp. 2086 – 2097.

extended to depths of approximately 5 to 7 feet below existing grades in Test Holes 1 and 2 (classroom addition), approximately 22 feet in Test Hole 3 (cafeteria addition), and approximately 2 and 3 feet in Test Holes RW-1 and PP-2. Greater depths of fill may be present elsewhere on site, particularly within the eastern portion of the site. Compaction test results were not provided to GROUND; therefore, it may be appropriate to consider these fill soils to be undocumented. Local geotechnical practice suggests that undocumented fill soils should be removed and replaced in a moisture-density controlled manner. In undocumented fill soils, there exists a largely unquantifiable risk of volume change of the fill (primarily from consolidation of materials) associated with the presence of unknown materials and voids in the fill. Though development of sinkholes or other large-scale volume changes in the existing fill likely is low, the risk of these features developing still exists where undocumented fill soils are not removed and replaced. In GROUND's experience, fills placed in areas outside of building footprints are typically not placed with the same compaction criteria as that of fill placed beneath building footprints. Therefore, these fill soils are considered by GROUND to be undocumented fill soils.

Additionally, because the existing fills were differential in thickness, with greater differential thicknesses anticipated based on the site's history and grades, the post-construction movements experienced by the addition likely would be highly differential were foundations to bear directly on them.

An addendum letter to the original geotechnical report for the facility (prepared by others) indicated that, "Adequate density testing was performed on the fill during placement…and the fill was placed on competent, stable subgrade." Even so, total settlements on the order of 2 to 6 inches were predicted in the original geotechnical report for the provided soil bearing pressure. The report also indicated that additional fills, on the order of approximately 5 to 10 feet were planned to facilitate the original facility grade.

Assuming all the existing fill soils were placed prior to and during the facility's original construction (25+ years ago), the risk of realizing significant additional settlements upon construction of the building addition (application of new loads) appears to be comparatively lower than a scenario in which new loads are/were imposed on younger (recently placed) fill soils. During a conference call with the Client and Design Team on February 22, 2023, we discussed the potential risks above with the Client. The Client

indicated that the risks associated with constructing the proposed additions on the existing fill materials were not acceptable at that time.

On May 26, 2023, the Project Structural Engineer proposed an approach for shallow foundation/floor system construction which entailed allowing any existing fills to remain in the classroom foundation subgrade below a depth of approximately 3 feet from the proposed building addition grade. We understand this proposed approach is being driven by cost considerations for the project. Based on a subsequent email from Jeffco Public Schools, we understand they are interested in pursuing the approach proposed by the Project Structural Engineer. The Client has also indicated that based on his knowledge that substantial movement of the existing building does not appear to have occurred, their opinion is the existing fill materials are "adequate."

Although groundwater was not encountered within the anticipated excavation depths (excluding deep foundation excavations), it has been our experience that surface and groundwater levels fluctuate greatly in mountainous areas, primarily due to seasonal conditions such as spring snow-melt and runoff. Subsurface moisture / water conditions are difficult to forecast. At sites like the subject property, these effects can be amplified by the strongly contrasting hydraulic conductivities of the sandy soils and the underlying crystalline rock, as well as by the irregularity of the contact between those materials. Perched groundwater conditions may lead to saturated conditions locally even where groundwater is significantly deeper at other times which may affect the longer-term performance of site improvements, including structures. This should be taken into account for foundation and utility excavations, cut slopes, and culvert sizing, etc. Furthermore, seasonal weather commonly causes completed components of a project to be compromised. If effective surface drainage has not been established and maintained during construction, these effects can be significantly more severe.

Likely Post-Construction Movements for Improvements Placed on Site Earth Materials We estimate foundations and floor systems placed directly on the site materials could experience movements of approximately 1½ to 5 inches or more (including differential and total movements). Lateral movements are anticipated to result as well. Foundation, slab, flatwork, and pavement movements of these same magnitudes can result in significant damage. Nearly all of the site improvements are vulnerable in this regard. In settings such as this site, maintenance measures should be anticipated to

include periodic removal and replacement of improvements not supported on deep foundations.

Based on a discussion with the Project Structural Engineer and a provided marked up site plan, we also understand imposition of new loads to existing building foundations is planned. We understand the Project Structural Engineer determined that the existing loading of the subject foundations did not utilize the maximum allowable soil bearing pressure provided in the original geotechnical report (3,000 psf). Provided information indicates new (additional) loads on the order of approximately 0.5 to 3 klf are planned for existing strip footings and that new loads on existing spread footings are also planned. Because the actual foundation subgrade conditions and detailed settlement history (i.e., as-built and current elevations for each foundation to receive additions loads) are unknown to GROUND, it is difficult to quantify the magnitude of likely post-construction movements. The Client and members of the Design Team indicated in the February 22nd, 2023 conference call that they were unaware of previous distresses to the building related to settlement and that no apparent signs of building distress have been observed. As discussed, movements of approximately 2 to 6 inches were estimated in the original geotechnical report for the provided soil bearing pressure. It is our opinion the likelihood of realizing additional movements of those magnitudes is relatively low. We estimate additional movements on the order of approximately ½ to ¾ inch could be realized for existing foundations upon which new loads will be imposed. If this inherent uncertainty (accurately estimating additional movement) is unacceptable to the Owner, foundations to receive additional/new loads should be structurally underpinned by micropiles or similar deep foundation system.

FOUNDATION/FLOOR SYSTEMS OVERVIEW

Based on provided information, we understand maximum column loads are anticipated to be on the order of approximately 100 kips and maximum wall loads are anticipated to be on the order of approximately 2 kips per foot.

A finish floor elevation (FFE) of approximately 7,711.17 feet is planned for the lowest level of the proposed classroom addition. Earthen cuts ranging up to approximately 4 feet are anticipated to be necessary to facilitate the proposed classroom addition grade.

Additionally, an existing buried water line located near the northern margin of the proposed addition footprint will be demolished.

Although a FFE was not indicated for the proposed cafeteria addition, we assume an FFE of approximately 7,711 feet is planned. Earthen fills ranging up to approximately 3 feet are anticipated to be necessary to facilitate the anticipated cafeteria addition grade.

Deep Foundation / Structural Floor System

In GROUND's opinion, supporting the proposed building on a drilled pier foundation system will provide the lowest estimated of likely post-construction foundation movement (about ½-inch, with similar differential movements over spans of about 40 feet) and will provide the least risk of excessive foundation movements. Drilled piers should bear in the comparatively unweathered bedrock beneath the site at a depth below the depth of wetting.

Constructing the lowest level building floor as a structural floor, also supported on drilled piers, will yield similarly low post-construction floor movement estimates. Exterior flatwork adjacent to the building, particularly at and near building entrances, also should be constructed as structural floors to reduce the potential for differential movement. Hinged slabs are not recommended for exterior flatwork adjacent to the building. A structural slab-on-void floor system could also be considered for this project.

The gneiss bedrock was very hard and relatively resistant, and while anticipated to provide ample foundation support, it will be relatively difficult to penetrate with this type of deep foundation. GROUND should be contacted to provide drilled pier parameters if they are desired.

Micropile Foundation / Structural Floor System

As another alternative, the building additions and their floor slabs could be supported on micropiles or similar, proprietary, deep foundation systems bearing in the bedrock. The use of micropiles or similar foundation systems will help reduce the differential movements between the existing building and the additions. Similarly, underpinning existing foundations upon which addition loads will be imposed, will help reduce the likelihood of inducing settlements/differential movements.

We suggest contacting the following designer/contractors for additional information and a foundation design, although others may be available.

- **DRS Engineering Contractors** (Highlands Ranch, Colorado) (303) 306-9200
- **Keller** (Commerce City, Colorado) (303) 469-1136
- **Park Range Construction** (Englewood, Colorado) (303) 781-8936
- **Schnabel Foundation Company** (Aurora, Colorado) (303) 696-7268

We anticipate that elements of these systems will bear in the bedrock beneath the site and below the depth of wetting (20 feet) that we considered appropriate, and that void forms at least 4 inches in thickness will be used. The actual depth of wetting, bearing depth, element capacity and other parameters used for design of the selected system; however, must be determined by the specialty designer/contractor.

It should be noted that these proprietary systems will be designed by an engineer associated with the specialty company that installs them. In that regard, this report may be relied upon by the specialty designer/contractor as a data report, only. We anticipate that the data in this report and in this report will be sufficient for the specialty designer/contractor to design the foundations, but if additional data are needed, the designer/contractor should obtain the necessary subsurface exploration, testing, etc.

As proprietary foundation systems designed and installed by others, GROUND cannot comment on the appropriateness or the anticipated performance of these systems. We cannot establish criteria for acceptance of a system, or 'accept' or 'approve' an installation. In particular, we are not able to comment on a given foundation element that was not installed per the designer/contactor's plan.

Micropiles are relatively slender and should be, battered, grouped, or laterally braced for stability, as necessary. Preliminary geotechnical considerations and parameters for micropiles are presented in the *Foundation Systems* section of this report. Geotechnical parameters for structural floors are provided in the *Floor Systems* section of this report.

Should post-construction movements in excess of 1 inch be of concern, a deep micropile foundation/structural floor system or other deeply founded system(s) should be used.

Aggregate Pier Ground Improvement - Shallow Foundation / Slab-on Grade Floor System

As an alternative to conventional earthwork to address the undocumented fills discussed previously, the site soils could be densified in-place by installation of aggregate piers, e.g., Geo-piers, rammed aggregate piers, or Vibro Piers. It is GROUND's opinion that rammed/aggregate piers could be utilized to improve the site subgrade soils and reduce the potential for settlement without construction of a uniform fill prism. If utilized, the rammed/aggregate piers should be installed to support both the footings and slabs.

Rammed/aggregate piers typically consist of either a drilled shaft, backfilled with coarse aggregate in lifts and compacted with a high frequency tamper or are constructed using a down hole vibrator to compact aggregate in-place in controlled lifts. This has the effect of densifying the surrounding soils, increasing bearing capacity and reducing post-construction settlements for elements supported on them. Installation of rammed/aggregate piers/vibro-piers should be considered beneath any proposed improvements sensitive to post-construction movements.

Based on our experience and conversations with industry representatives, we understand estimated, post-construction settlements of approximately 1 inch may be achievable if the available geotechnical data, foundation plan, structural loads, and movement tolerances are supplied to the design/build contractor. We understand rammed/aggregate pier systems are capable of providing allowable bearing pressures of 4,000 to 6,000 psf or more, with associated settlements of approximately 1 inch. The actual bearing pressures, etc., for shallow foundations as well as potential post-construction movement estimates (foundations and floor slabs) should be provided by the designer/contractor.

Rammed/aggregate pier systems are proprietary foundation systems and the element layout and design parameters will be provided by the specialty designer/contractor. The data in this report should be sufficient for the designer/contractor to develop their design. It should be noted that these proprietary systems will be designed by an engineer associated with the specialty company that installs them. In that regard, this report may be relied upon by the specialty designer/contractor as a data report, only. We anticipate that the data in this report and in this report will be sufficient for the specialty designer/contractor to design the foundations, but if additional data is needed, the designer/contractor should obtain the necessary subsurface exploration, testing, etc. We

suggest contacting either of the following designer/contractors, although others may be available:

- **Ground Improvement Engineering** – "Geopiers" (816) 421-4334
- **Keller** – "Vibro Piers (303) 469-1136

Quality control observation of rammed/aggregate pier installation, as well as vibration monitoring of nearby structures sensitive to vibration and settlement can be beneficial during project construction. GROUND is available to provide installation observation and vibration monitoring upon request under separate contract.

As proprietary foundation systems designed and installed by others, GROUND cannot comment on the appropriateness or the anticipated performance of these systems. We cannot establish criteria for acceptance of a system, or 'accept' or 'approve' an installation. In particular, we are not able to comment on a given foundation element that was not installed per the designer/contactor's plan.

Full Over-Excavation of Fills - Shallow Foundation / Floor System – Classroom Addition

As an alternate foundation and floor system (but not equal in performance) for the proposed classroom addition, a shallow foundation and floor system consisting of spread footings and a slab-on-grade floor system may be utilized for the proposed structure provided over-excavation is performed and a remedial uniform fill thickness (fill prism) is constructed beneath and beyond the addition (sides not connected to the existing building) in order to reduce (but not eliminate) the potential for movement (settlement). The fill prism may consist of site-generated soils or approved import soils placed in a moisture-density treated manner (see the *Project Earthwork* section of this report). A remedial uniform fill prism thickness of at least **7 feet** consisting should be constructed beneath the underslab gravel layer. If existing man-made fill materials are observed at greater depths within the proposed addition footprint, a thicker fill prism will be necessary to be constructed.

The remedial uniform fill prism should extend laterally approximately 7 feet beyond the building addition (sides not connected to the existing building) and beneath any building appurtenances including entryways, patios, courtyards, etc. Utilizing a fill prism consisting of site-generated soils or approved import materials as well as other applicable suggestions provided in this report, GROUND estimates potential movements associated

with settlement on the order of approximately 1 inch and differential movements on the order of ½ inch over a distance of 30 feet. Geotechnical parameters for shallow foundations are provided in the *Foundation Systems* section of this report. Geotechnical parameters for slab-on-grade floors are provided in the *Floor Systems* section of this report.

Differential Over-Excavation of Fills - Shallow Foundation / Floor System – Classroom Addition

As discussed, the Project Structural Engineer proposed an alternative approach to remedial earthwork beneath the proposed classroom addition. This approach would entail excavation to a depth of approximately 3 feet below finished grade or to the existing footing bearing elevation near the existing building to avoid comparatively risky/complicated excavations which would likely require shoring and/or underpinning of the existing structure. The proposed remedial excavation bottom would be sloped down to the north until it reaches the full depth of existing fill materials (anticipated to be at least 7 feet below proposed grade based on the conditions encountered in the test holes). This approach will result in a wedge of existing fill materials overlain by a wedge of new fill materials beneath the foundations and floor slabs within the southern portion of the addition. The remainder of the addition footprint would be underlain by a remedial uniform fill prism thickness of at least **7 feet** taken from beneath the underslab gravel layer.

As discussed, constructing the addition on the existing fill materials is associated with a somewhat unquantifiable risk of post-construction movements due to its undocumented nature. The only way to significantly reduce this risk and provide more constrained estimates of post-construction movements would be to remove and replace all existing fill in a controlled and uniform manner. However, we understand the Client's opinion is that the existing building has not experienced substantial movements and therefore, the existing fill is adequate. Even so, the existing fills and new fills are anticipated to settle differentially upon loading.

The excavation slope extending down to the full fill prism depth should be a maximum of 45 degrees (1:1) taken from the existing foundation bearing elevation (exterior footing edge).

The fill prism may consist of site-generated soils or approved import soils placed in a moisture-density treated manner (see the *Project Earthwork* section of this report). If existing man-made fill materials are observed at greater depths within the proposed addition footprint, a thicker fill prism will be necessary to be constructed.

The remedial uniform fill prism should extend laterally approximately 7 feet beyond the building addition (sides not connected to the existing building) and beneath any building appurtenances including entryways, patios, courtyards, etc. Utilizing a fill prism consisting of site-generated soils or approved import materials as well as other applicable suggestions provided in this report, GROUND estimates potential movements associated with settlement on the order of approximately 1 inch or more and differential movements on the order of ½ inch or more over a distance of 30 feet. The likelihood of realizing movements greater than those estimated above is due to the largely unquantifiable performance characteristics of the existing fill which will remain in the southern portion of the addition subgrade. Utilization of a lower soil bearing capacity is anticipated to somewhat reduce (but not eliminate) the risk of greater post-construction movements. Geotechnical parameters for shallow foundations are provided in the *Foundation Systems* section of this report. Geotechnical parameters for slab-on-grade floors are provided in the *Floor Systems* section of this report.

Additional Considerations

- The additions will move differentially after construction relative to the existing structure. Therefore, the additions should be isolated structurally from the existing structure to reduce damage from differential movements. Finishes spanning between the addition and the existing school should be designed and constructed such that they can be readily maintained or replaced.

- As the proposed additions will abut the existing building, appropriate measures should be taken to prevent damage to the existing building. The use of geotechnical instrumentation (vibration monitoring, inclinometers, etc.) in conjunction with pre-construction building distress surveys may be useful in this regard.

- If a remedial fill prism is to be constructed beneath the proposed additions, a structural engineer should evaluate the effects of the removal of the excavated soil on the existing building's foundation and floor system. Temporary shoring of the existing

building will also be necessary to facilitate a uniform fill prism thickness beneath the proposed classroom addition. An increased risk for differential movement will exist in the event a non-uniform fill prism is constructed beneath the classroom addition footprint.

- In the event the Client selects to construct a uniform fill prism to support a shallow foundation/slab-on-grade floor system, the performance of the building will strongly be controlled by the quality of the as-constructed fill prism. Effective and consistent fill placement will be necessary to ensure the fill section is uniformly constructed. Variations in fill density, moisture content, etc. will result in variable performance and may increase differential movements.

- In general, we anticipate the majority of the existing site soils, including the fill soils, will be suitable geotechnically to be re-used as fill. However, because not all of the fill materials were samples and tested, some of these materials may not be suitable for reuse.

- Inadequate site drainage and/or ineffective fill processing will also result in an increase in the movement estimates provided. In addition, realized movements may be more or less depending on the subsurface materials present and the overall site drainage after construction is completed and landscape irrigation commences. In the event the earth materials supporting the proposed building's foundation and floor systems experiences moisture infiltration, post-construction movements in excess of these provided herein should be anticipated.

- GROUND recommends the use of a deep foundation system and structurally supported floors if movements of 1 inch or more cannot be tolerated. This approach is also anticipated to present the least risk of distress/adverse impacts to the existing building.

FOUNDATION SYSTEMS

The geotechnical parameters below may be used for design of foundations for the proposed structure, selected based on acceptance of the risks discussed in the Geotechnical Considerations for Design and Foundation/Floor Systems Overview sections of this report.

Geotechnical Parameters for Preliminary Design of Micropile Foundations

Parameters are provided below for preliminary design of micropile foundations. The geotechnical parameters for lateral loading analysis provided below also may be referenced for analysis of proprietary foundation elements with appropriate adjustment for element width. The actual design for a micropile foundation will be developed by the specialty foundation contractor.

In general, foundation elements of these types are available in diameters between 5 and 12 inches and with allowable capacities up to about 200 tons. The specialty foundation contractor and the structural engineer should coordinate to determine the type, number, layout, length, and necessary vertical and lateral capacities of such a foundation system. Battered elements or multiple elements may be needed to resist lateral loads. We anticipate that the geotechnical information in this report will be adequate for the specialty contractor to develop a design in coordination with the structural engineer.

We suggest that one or more test micropiles be advanced at the site prior to completion of design to evaluate installation conditions and to optimize the design, including anticipated installation lengths.

1) The micropiles should be founded in the gneiss bedrock.

2) The grout to ground bond strength bond for use in design of micropiles should be determined by the micropile designer based on the type of installation equipment and the technique anticipated.

3) Micropiles should be of sufficient length support both the anticipated axial loads and down drag load of the existing fill. Micropiles should have a minimum length of at least 30 feet and a minimum diameter of 4 inches.

4) Micropiles should be reinforced adequately, as determined by the structural engineer.

5) Uncased micropile drill holes should be cleaned prior to the placement of reinforcing steel and grout. Cleaning typically consists of jetting high pressure air or water from the bottom of the hole to clean smeared soil from the sidewalls and

remove caked sidewall material weakened by drilling fluids or groundwater immediately prior to placement of reinforcing steel and grout.

6) Difficult drilling conditions, including cobbles, boulders, and hard bedrock, should be anticipated.

7) Grout should be placed from the bottom up by an approved tremie technique.

8) Reinforcing steel should be centered in the drill holes to provide adequate grout cover for corrosion protection. Grout cover should be a minimum of 1 inch. A minimum sacrificial thickness should be included in the reinforcing steel.

9) Geotechnical parameters for resisting lateral loading of micro-piles are provided in the *Lateral Earth Pressures* section of this report. Micropiles designed for lateral loads may need to be battered.

10) Reduction of axial capacities can be avoided by spacing micropiles apart a distance of at least 3 diameters center to center. Reduction factors for micropiles spaced more closely than 3 diameters center to center can be obtained from Figure 5.

Geotechnical Parameters for Shallow Foundation Design

1) Footings should bear on a fill prism consisting of properly moisture-conditioned and compacted site-generated soils or approved import soils as discussed in the *Foundation/Floor System Overview* section. The fill prism should extend laterally at least 7 feet beyond the perimeter of the classroom addition (except for sides connected to the existing building).

Considerations for fill placement and compaction are provided in the *Project Earthwork* section of this report.

The fill section should be laterally consistent and of uniform thickness to reduce differential, post-construction foundation movements. A differential fill section will tend to increase differential movements.

The contractor should provide survey data of the excavation beneath the building indicating the depth and lateral extents of the remedial sub-excavation.

2) Footings bearing on a uniform fill prism may be designed for an allowable soil bearing pressure of 2,500 psf for a fill prism consisting of site-generated soils or approved import materials for footings up to 6 feet in width (maximum load of approximately 100 kips). In the event the footing width is greater than those discussed above to accommodate greater loads, we should be notified to reevaluate these parameters.

These values may be increased by ⅓ for transient loads such as wind or seismic loading. For larger footings, a lower allowable bearing pressure may be appropriate.

Compression of the bearing soils for the provided allowable bearing pressure is estimated to be 1 inch, based on an assumption of drained foundation conditions. If foundation soils are subjected to an increase/fluctuation in moisture content, the effective bearing capacity will be reduced and greater post-construction movements than those estimated above may result.

This estimate of foundation movement from immediate compression of the foundation soils is a component of the total, likely, post-construction movement estimated for the buildings at this site. (See the *Foundation/Floor Systems Overview* section of this report.) It is in addition to movements from post-construction volume change in the native soils underlying the site and from densification of the fill section constructed beneath the building, as discussed above.

To reduce differential settlements between footings or along continuous footings, footing loads should be as uniform as possible. Differentially loaded footings will settle differentially.

3) Spread footings should have a minimum lateral dimension of 16 or more inches for linear strip footings and 24 inches for isolated pad footings. Actual footing dimensions should be determined by the structural engineer.

4) Footings should bear at an elevation 3 or more feet below the lowest adjacent exterior finish grades to have adequate soil cover for frost protection

5) Continuous foundation walls should be reinforced as designed by a structural engineer to span an unsupported length of at least 10 feet.

6) Geotechnical parameters for lateral resistance to foundation loads are provided in the *Lateral Earth Pressures* section of this report.

7) Connections of all types must be flexible and/or adjustable to accommodate the anticipated, post-construction movements of the structure.

8) To the extent possible, utility lines should not be routed under shallow foundations, particularly isolated pad foundations, nor in the soils supporting the foundations. Where doing so cannot be avoided, there is increased risk to both the pipe and the foundation. Measures should be included in design to protect both the footings from increased settlement (such as backfilling the utility trench with Controlled Low Strength Material" (CLSM), i.e., a lean, sand-cement slurry ("flowable fill") or a similar material) and to protect the pipe from deformation.

   Where utility lines penetrate footings or stem walls, etc., measures should be included to accommodate the likely total and differential, post-construction movements discussed in this report. Some footings also may experience lateral displacements as structural loads are applied.

Shallow Foundation Construction

9) The contractor should take adequate care when making excavations not to compromise the bearing or lateral support for nearby improvements.

10) Care should be taken when excavating the foundations to avoid disturbing the supporting materials particularly in excavating the last few inches.

11) Footing excavation bottoms may expose loose, organic or otherwise deleterious materials, including debris. Firm materials may become disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill or the foundations deepened.

12) Foundation-supporting soils may be disturbed or deform excessively under the wheel loads of heavy construction vehicles as the excavations approach footing bearing levels. Construction equipment should be as light as possible to limit development of this condition. The movement of vehicles over proposed foundation areas should be restricted.

13) All foundation subgrade should be properly moisture-density treated prior to placement of concrete.

14) Fill placed against the sides of the footings should be properly compacted in accordance with the *Project Earthwork* section of this report.

FLOOR SYSTEMS

The geotechnical parameters below may be used for design of floors for the proposed structure, selected based on acceptance of the risks discussed in the Geotechnical Considerations for Design and Foundation/Floor Systems Overview sections of this report.

Structural Floor

A structural floor should be utilized for the proposed structure as the floor system resulting in the least potential for post-construction floor movement, including differential movement. Entryway floor slabs/systems should be constructed as structural floors unless movements of several inches can be tolerated.

Structural floors should be supported on grade beams and straight-shaft drilled piers or micropiles in the same manner as the building structure. Requirements for the number and position of additional piers to support the floors will depend upon the span, design load, and structural design, and should be developed by the Structural Engineer. Geotechnical information for design and installation of drilled piers are provided in the *Foundation System* section of this report.

Structural floors should be constructed to span above a well-ventilated crawl space, permitting utility lines to be installed above the consolidating materials. The crawl space should be adequately sized to allow access to and maintenance of utility piping. Piping connections through floors, grade beams, or foundation walls should allow for differential

movement between the piping and the structural element through which the piping is penetrating.

A vapor barrier, water proofing, and other means of preventing moisture intrusion should be utilized where appropriate. A vapor barrier meeting ASTM E-1745 (Class "A") should be considered for installation below all structurally supported floors and if utilized, should be properly attached/sealed to foundation walls/drilled piers above the void material. The sheet material should not be attached to horizontal surfaces such that condensate might drain to wood or corrodible metal surfaces.

Use of polyethylene ("poly") sheeting as a vapor barrier is not suggested. Polyethylene ("poly") sheeting (even if 15 mils in thickness which polyethylene sheeting commonly is not) does not meet the ASTM E-1745 criteria and is not suggested for use as vapor barrier material. It can be easily torn and/or punctured, does not possess the necessary tensile strength, gets brittle, tends to decompose over time, and has a relatively high permeance.

New buildings generally lack ventilation due primarily to systematic efforts to construct air-tight, energy-efficient structures. Therefore, areas such as crawl spaces beneath structural floors are typically areas of elevated humidity which never completely dry. This condition can be aggravated in some locations by shallow groundwater or a perched groundwater condition, which can result in saturated soils within several feet of the finished building pad grade. Persistently warm, humid conditions in the presence of cellulose, which is found in many typical construction materials, creates an ideal environment for the growth of molds, fungi and mildew. Published data suggest links between molds and illnesses. Therefore, crawl spaces beneath structural floors should be provided with adequate, active ventilation systems or other active mechanisms such as specially designed HVAC systems to reduce the potential for mold, fungus and mildew growth. Crawl spaces should be inspected periodically so that remedial measures can be taken in a timely manner, should mold, fungus or mildew be present and require removal.

The Owner must be willing to accept the risks of potential mold, fungus and mildew growth when electing to utilize a structural floor system. Additionally, the contractor is solely responsible for the means and methods during construction including adequate ventilation, and any observation or testing performed during construction does not relieve the contractor of that responsibility.

All plumbing lines should be carefully tested before operation. Where utility lines enter through the floor, positive bond breaks should be provided. Utility lines can be displaced by soils and bedrock movements, which are not reflected in the building. Design and installation of associated fixtures should accommodate this potential differential movement, which could be on the order of 2 inches or more.

Slab-on-Void Floor

Based on GROUND's experience with similar projects, as an alternate structural floor system, the proposed floor could be constructed as a structural slab-on-void form in lieu of a structural floor system over a ventilated crawl space. Typically, commercial cardboard void is utilized which is intended to degrade overtime. In the event a structural slab-on-void form is utilized, a minimum void form thickness of **4 inches** should be used. The void form should be able to accommodate 4 inches of soil movement following complete vertical compression. Greater void thickness could also be considered. The Client/Owner should be aware that to our knowledge, there is no floor system that will provide the same tolerance for floor movements as would be provided by a structural floor system placed over a well-ventilated crawl space.

Please note that by utilizing a structural floor spanning above a crawl space, as indicated previously, this would permit utility lines to be installed (hung) above the soils. GROUND would anticipate that utilities placed in soil trenches beneath a structural slab-on-void may be subjected to these materials. Piping connections through the floor should allow for differential movement between the piping and floor system (flexible). All plumbing lines should be carefully tested before operation. Where utility lines enter through the floor, positive bond breaks should be provided. Utility lines can be displaced by soil movements, which are not reflected in the building. Design and installation of associated fixtures should accommodate this potential differential movement.

Slab-on-Grade Floors

Geotechnical Parameters for Slab-on-Grade Floors

1) Prior to placement of lightly loaded slabs, a uniform fill prism as discussed in the *Foundation/Floor System Overview* section should be constructed. The fill section should extend at full depth at least 7 feet laterally beyond the slab perimeter

(except for areas in conflict with existing structures). In the event a differential fill thickness is constructed, differential slab movements should be anticipated.

2) An allowable subgrade vertical modulus (K) of 75 pci may be utilized for lightly loaded slabs supported by the site soils.

3) The prepared surface on which the slabs will be cast should be observed by the Geotechnical Engineer prior to placement of reinforcement. Exposed loose, soft, or otherwise unsuitable materials should be excavated and replaced with properly compacted fill, placed in accordance with the *Project Earthwork* section of this report. All slab subgrade should be properly moisture-density treated prior to placement of concrete.

4) Slabs should be separated from all bearing walls and columns with slip joints, which allow unrestrained vertical movement.

5) Joints should be observed periodically, particularly during the first several years after construction. Slab movement can cause previously free-slipping joints to bind. Measures should be taken to assure that slab isolation is maintained in order to reduce the likelihood of damage to walls and other interior improvements.

6) Interior partitions (if applicable) resting on floor/concrete slabs should be provided with slip joints so that if the slabs move, the movement cannot be transmitted to the upper structure. This detail is also important for wallboards and door frames. A slip joint, which will allow at least 2 or more inches of vertical movement, is recommended. If slip joints are placed at the tops of walls, in the event that the slabs move, it is likely that the wall will show signs of distress, especially where the slabs meet the exterior wall.

7) Concrete slabs-on-grade should be placed on properly prepared subgrade. They should also be constructed and cured according to applicable standards and be provided with properly designed and constructed control joints. The design and construction of such joints should account for cracking as a result of shrinkage, tension, and loading; curling; as well as proposed slab use. Joint layout based on the slab design may require more frequent, additional, or deeper joints, and should also be based on the ultimate use and configuration of the slabs. Areas where

slabs consist of interior corners or curves (at column blockouts or around corners) or where slabs have high length to width ratios, high degree of slopes, thickness transitions, high traffic loads, or other unique features should be carefully considered. The improper placement or construction of control joints will increase the potential for slab cracking. ACI, AASHTO, and other industry groups provide many guidelines for proper design and construction of concrete slabs-on-grade and the associated jointing.

8) Slabs should be adequately reinforced. Structural considerations for slab thickness, jointing, and steel reinforcement in floor slabs should be developed by the Structural Engineer. Placement of slab reinforcement continuously through the control joint alignments will tend to increase the effective size of concrete panels and reduce the effectiveness of control joints.

9) All plumbing lines should be carefully tested before operation. Where plumbing lines enter through the floor, a positive bond break should be provided. Flexible connections allowing 2 or more inches of vertical movement should be provided for slab-bearing mechanical equipment.

10) Moisture can be introduced into a slab subgrade during construction and additional moisture will be released from the slab concrete as it cures. Placement of a properly compacted layer of free-draining gravel, 4 or more inches in thickness, beneath the slabs should be performed. This layer will help distribute floor slab loadings, ease construction, reduce capillary moisture rise, and aid in drainage. The free-draining gravel should contain less than 5 percent material passing the No. 200 Sieve, more than 50 percent retained on the No. 4 Sieve, and a maximum particle size of 2 inches. It has been our experience that the use of CDOT Class 5 or 6 Aggregate Base Course (ABC) has been employed as a base layer for concrete slabs on grade. While CDOT Class 5 or 6 ABC is not an equivalent to the free-draining gravel discussed above and does not provide an equivalent degree of capillary break, it is often used to address ACI's recommendation for a coarse-grained, granular base material that is easily trimmable and has a relatively low fines (percent passing #200 sieve) content.

11) A vapor barrier beneath a building floor slab is beneficial with regard to reducing sub-slab moisture vapor transmission through the floor slab and into the building, but can retard downward drainage of construction moisture. Elevated vapor fluxes can be detrimental to the adhesion and performance of many floor coverings and can also contribute to other moisture-induced concerns. Thus, an effective sub-slab vapor barrier is a published industry requirement for most slab-on-ground construction (i.e., IBC, ASTM), regardless of project location, soil conditions, and water table depth.

Per ACI 302.2R-15, a vapor barrier is recommended under concrete slabs-on-ground when they will receive (or could receive in the future) moisture-sensitive floor coverings, coatings, adhesives, underlayments, and/or stored goods. Moreover, ACI recommends a vapor barrier for any building which will be humidity or climate controlled, including exposed slabs (such as industrial warehouse). ACI 302 provides further guidance on the location of the vapor barrier beneath the slab.

However, when slabs are placed directly on the vapor barrier, considerations and steps may be needed to help reduce uneven drying/shrinkage concerns and potential slab curl.

Therefore, Jeffco Public Schools, the architect, and/or contractor should weigh many considerations when designing and implementing the sub-slab vapor barrier system, including building use and operating conditions, flooring products, sub-base (gravel layer) type, size, and thickness, expected construction traffic, etc.

When a vapor barrier is used, it should consist of a minimum 15-mil thickness, extruded polyolefin plastic (no recycled content or woven materials), maintain a permeance less than 0.01 perms per ASTM E96 or ASTM E1249 before and after mandatory conditioning testing, and comply with ASTM E1745-17 (Class “A”). Vapor barriers should be installed in accordance with ASTM E1643-18 and the manufacturer’s guidelines. (Note that Polyethylene (“poly”) sheeting (even if 15 mils in thickness which polyethylene sheeting commonly is not) does not meet the ASTM E1745 criteria and generally should not be used as a vapor barrier material.)

Slab movements are directly related to the increases in moisture contents to the underlying soils after construction is completed. The precautions and parameters itemized

above will not prevent the movement of floor slabs if the underlying materials are subjected to moisture fluctuations. However, these steps will reduce the damage if such movement occurs.

MECHANICAL ROOMS/MECHANICAL PADS/TRASH ENCLOSURES

Often, slab-bearing mechanical rooms/mechanical equipment/trash enclosures are incorporated into projects. Our experience indicates these are located as partially below-grade or adjacent to the exterior of a structure. These elements should be founded on the same type of foundation systems as the main structure. Furthermore, mechanical connections must allow for potential differential movements.

LATERAL EARTH PRESSURES

Values for equivalent fluid pressures and the coefficient for frictional resistance to sliding are provided below. These values were approximated based on a moist unit weight (γ') of 130 pcf and an angle of internal friction (Φ) of 24 degrees for site soils reworked as properly compacted fill. Values for equivalent fluid pressures and the coefficient for frictional resistance to sliding for CDOT Class 1 Structure Backfill for use in a retaining wall backfill are presented at the end of this section. These values assume a drained condition, are unfactored and appropriate factors of safety should be included in design calculations. The additional loading of an upward sloping backfill as well as loads from traffic, stockpiled materials, etc. should be included in the design.

Shallow Foundations Resisting Lateral Loads A friction coefficient of **0.30** between a shallow element and the site soils may be used for design of shallow foundations and thrust blocks resisting lateral loads.

Passive soil pressure at this site may be estimated using an equivalent fluid pressure of **265 pcf** for drained conditions, to a **maximum of 2,650 psf**. The upper 1 foot of embedment should be neglected for passive resistance. Where passive pressure is used to resist lateral loads, it should be understood that significant lateral strains will be required to mobilize the full value indicated above, likely 1 inch or more; however, a reduced passive pressure can be used for reduced anticipated strains.

At-Rest and Active Lateral Earth Pressures Site soils placed as backfill against a structure in an **at-rest** condition may be considered to exert an equivalent fluid unit weight of **78 pcf**.

Site soils placed as backfill where the full, **active** earth pressure condition applied may be considered to exert an equivalent fluid unit weight of **55 pcf**.

CDOT Class 1 Structure Backfill or Better) Values for equivalent fluid pressures and the coefficient for frictional resistance to sliding are provided below for CDOT Class 1 Structure Backfill. These values were approximated based on a moist unit weight (γ') of 135 pcf and an angle of internal friction (Φ) of 34 degrees for properly compacted fill. A **friction coefficient** of **0.45** between a shallow element and structural fill may be used for design of shallow foundations and thrust blocks resisting lateral loads. **Passive soil pressure** may be estimated using an equivalent fluid pressure of **435 pcf** for drained conditions**,** to a **maximum of 4,350 psf** (see considerations above for additional considerations regarding these values). Structural fill placed as backfill against a structure in an **at-rest** condition may be considered to exert an equivalent fluid unit weight of **60 pcf**. Structural fill placed as backfill where the full, **active earth pressure** condition applied may be considered to exert an equivalent fluid unit weight of **39 pcf**.

Deep Foundations Resisting Lateral Loads Based on the data obtained for this study and our experience with similar sites and conditions, lateral load analysis using the "L-Pile" or a similar computer program should use the following geotechnical parameters for input at the proposed maintenance shed. The parameters are based on a simplified soil profile in which CLA is applicable to the classroom addition and CAF is applicable to the cafeteria addition. These include, effective unit weights (γ), angle of internal friction (ϕ), and soil modulus parameter (k). Resistance to lateral loads should be neglected in the upper **3 feet** of material, whether fill or native. The gneiss bedrock could theoretically be modeled as Weak Rock (Reese); however, subsurface rock coring was beyond our scope of services. GROUND can provide a proposal upon request to remobilize to the site and obtain cores of the site bedrock if desired.

GEOTECHNICAL PARAMETERS FOR LATERAL LOAD ANALYSIS USING L-PILE

Soil / Bedrock Material	Approximate Depth Range	Parameter	Value
FILLS *(model as Sand)*	4 – 7 feet (CLA) 4 – 22 feet (CAF)	γ	120 pcf
		ϕ	22 degrees
		k	35 pci
Silty to Clayey SANDS with Gravels (*model as Sand)*	7 – 31 (CLA) 22 – 37 (CAF)	γ	125 pcf
		ϕ	26 degrees
		k	75 pci
GNEISS Bedrock *(model as Sand)*	>31 feet (CLA) >37 feet (CAF)	γ	130 pcf
		ϕ	29 degrees
		k	225 pci

RETAINING WALLS

As discussed, we understand retaining walls are planned to achieve project lines and grades. Based on the data obtained, we can provide the following preliminary information regarding site retaining walls. Depending on the final locations and heights of the walls, additional geotechnical evaluation may be necessary and may indicate that different parameters are appropriate.

Preliminarily, both cantilevered walls and mechanically stabilized earth (MSE) walls appear feasible at this site to support the proposed grade changes. However, given that MSE walls are more tolerant of post-construction movements, MSE walls may be more practical at this site. We also understand MSE wall are currently planned by the Design Team.

MSE Walls An MSE wall system will bear at shallow depths but is flexible and, in our experience, will be relatively tolerant of total and differential post-construction movements. Therefore, an MSE wall should bear on a section of properly compacted fill, native soils or bedrock. Structure backfill (CDOT Class 1) should be utilized within the reinforced backfill zone of MSE walls. Geotechnical parameters for fill placement and compaction are provided in the *Project Earthwork* section of this report. It must be understood that an

MSE wall will move after completion and that movement generally will be noticeably differential.

Bearing capacity for an MSE retaining wall should be developed by the wall designer based on the width of the wall reinforced zone using the parameters presented below for retaining wall design and Meyerhoff or other appropriate bearing capacity methods. Movement potential and services limit states should be evaluated by the wall designer based on the soil conditions and anticipated wall bearing pressure. If soil improvements for bearing capacity and/or service limits are considered necessary, a geotechnical engineer should be retained to provide additional parameters and considerations.

Based on the available geotechnical data, we preliminarily anticipate that the wall subgrade materials will typically consist of fills, native silty to clayey sands with gravels, and potentially gneiss bedrock (locally). The estimated soil parameters for use in the retaining wall planning and preliminary design are summarized in the following table.

Material Type	**Moist Unit Weight** *(pcf)*	**Internal Friction Angle** *(degrees)*
FILLS	130	24
Silty to Clayey SANDS with Gravels	130	26
GNEISS Bedrock	130	29
CDOT Class 1 Structure Backfill	135	34

Additional Retaining Wall Considerations Retaining walls should be provided with drains at the toe of the walls, or with weep holes, to help reduce the development of hydrostatic loads and water infiltration to the subgrade soils. A properly constructed wall drain system should be included in the retaining walls. Drainage systems in retaining walls are intended to collect and divert water infiltration or natural seepage.

In addition to surrounding the drain pipes with at least 6 inches of free-draining gravel, the gravel should extend upward to within 12 inches of the backfill surface behind the wall or the wall should be backed with a layer of geocomposite drainage medium, e.g., an appropriate MiraDrain® product or approved equivalent. The gravel or drainage product

backing the wall should be in hydraulic connection with the wall toe drain. If gravel backfill is selected, it should be separated from the enclosing soils by a layer of filter fabric to reduce the migration of fines into the gravel.

Wall drain systems are typically not intended to handle surface runoff or concentrated water at the top of walls, which should be collected and diverted by properly designed and constructed storm drainage features. The areas surrounding the retaining walls should be carefully graded to provide positive surface drainage away from the walls. Landscape irrigation around retaining walls should be reduced to a minimum throughout the life of the retaining walls. The wall systems and the surrounding areas must be kept relatively dry at all times during and after the construction to prevent water from infiltrating into the wall systems. In no case shall surface runoff be allowed to enter the wall construction areas, or water be allowed to pond above the walls. Temporary and permanent slopes and other stripped areas shall be adequately protected against erosion. Erosion along walls and slopes will result in sloughing and could lead to a wall failure.

We were unaware of the retaining wall system planned at the site at the time of this report preparation. As discussed, MSE walls are flexible retention systems, and should be anticipated to move both laterally and vertically after construction. If surface improvements, such as flatworks, sidewalks, curbs and gutters, pavements, fences, guardrails, utility pads, storm features, and manholes are installed near the walls, the anticipated wall movement often results in movement of the nearby surface improvements. Surface runoff infiltrating through joints of these surface improvements into wall backfill can aggravate movements of these surface improvements and the walls. Therefore, surface improvements and storm features should be located away from the wall systems. All of the joints of surface improvements must be properly sealed and maintained throughout the life of the wall systems.

Underground wet utility lines, such as waterlines, storm sewers, sanitary sewers, irrigation lines, and water features installed within or near retaining wall backfill are susceptible to leaks due to potential wall movements. Utility line leaks can also induce retaining wall movements and result in wall failures. Therefore, we strongly recommend that wet utility lines be installed away from retaining wall systems. In the event that wet utility lines or water features are installed within or near retaining wall backfill, the bottom of utility

trenches or water features shall be properly lined to prevent water from infiltrating into the wall systems.

WATER-SOLUBLE SULFATES

The concentrations of water-soluble sulfates measured in selected samples retrieved from the test holes was 0.01 and 0.06 percent (See Table 2). Such concentrations of water-soluble sulfates represent a negligible environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the "Design and Control of Concrete Mixtures," published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	**Water-Soluble Sulfate (SO_4) In Dry Soil** *(%)*	**Sulfate (SO_4) In Water** *(ppm)*	**Water Cementitious Ratio** *(maximum)*	**Cementitious Material Requirements**
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on our test results and PCA and CDOT guidelines, all concrete exposed to site soils should use sulfate-resistant cement conforming to one of the following requirements:

Class 0 (Negligible)

1) ASTM C150 Type I, II, III, or V.

2) ASTM C595 Type IL, IP, IP(MS), IP(HS), or IT.

The contractor should be aware that certain concrete mix components affecting sulfate resistance including, but not limited to, the cement, entrained air, and fly ash, can affect workability, set time, and other characteristics during placement, finishing and curing. The contractor should develop mix(es) for use in project concrete which are suitable with

regard to these construction factors, as well as sulfate resistance. A reduced, but still significant, sulfate resistance may be acceptable to the owner, in exchange for desired construction characteristics.

SOIL CORROSIVITY

The degree of risk for corrosion of metals in soils commonly is considered to be in two categories: corrosion in undisturbed soils and corrosion in disturbed soils. The potential for corrosion in undisturbed soil is generally low, regardless of soil types and conditions, because it is limited by the amount of oxygen that is available to create an electrolytic cell. In disturbed soils, the potential for corrosion typically is higher, but is strongly affected by soil chemistry and other factors.

A preliminary corrosivity analysis was performed to provide a general assessment of the potential for corrosion of ferrous metals installed in contact with earth materials at the site, based on the conditions existing at the time of GROUND's evaluation. Soil chemistry and physical property data including pH, reduction-oxidation (redox) potential, and qualitative sulfide content were obtained. Test results are summarized on Table 2.

Soil Resistivity In order to assess the "worst case" for mitigation planning, samples of materials retrieved from the test holes were tested for resistivity in the in the laboratory, after being saturated with water, rather than in the field. Resistivity also varies inversely with temperature. Therefore, the laboratory measurements were made at a controlled temperature. A measurement of electrical resistivity indicated values of approximately 5,445 and 9,643 ohm-centimeters in samples of the site soils.

pH Where pH is less than 4.0, soil serves as an electrolyte; the pH range of about 6.5 to 7.5 indicates soil conditions that are optimum for sulfate reduction. In the pH range above 8.5, soils are generally high in dissolved salts, yielding a low soil resistivity (AWWA, 2010). Testing indicated pH values of approximately 7.6 and 8.2.

Reduction-Oxidation Potential testing indicated negative potentials: approximately -63 and -22 millivolts. Such low potentials typically creates a more corrosive environment. The redox potential of a soil is significant, because the most common sulfate-reducing bacteria can only live in anaerobic conditions. A negative redox potential indicates anaerobic conditions in which sulfate reducers thrive.

Sulfide Reactivity testing for the presence of sulfides indicated 'trace' results. The presence of sulfides in the site soils also suggests a more corrosive environment. A positive sulfide reaction reveals a potential problem caused by sulfate-reducing bacteria. Anaerobic conditions are regarded as potentially corrosive.

Corrosivity Assessment The American Water Works Association (AWWA, 2010[6]) has developed a point system scale used to predict corrosivity. The scale is intended for protection of ductile iron pipe but is valuable for project steel selection. When the scale equals 10 points or higher, protective measures for ductile iron pipe are suggested. The AWWA scale (Table A.1 Soil-test Evaluation) is presented below. The soil characteristics refer to the conditions at and above pipe installation depth.

TABLE A.1 SOIL-TEST EVALUATION

Soil Characteristics	*Values*	*Points*
Resistivity *(Ω-cm)*	< 1,500	10
	≥ 1,500 – 1,800	8
	> 1,800 – 2,100	5
	> 2,100 – 2,500	2
	> 2,500 – 3,000	1
	> 3,000	0
pH	0 – 2	5
	2 – 4	3
	4 – 6½	0
	6½ – 7½	0*
	7½ – 8½	0
	> 8½	3
Redox Potential *(mV)*	< 0	5
	0 – 50	4
	50 – 100	3½
	> 100	0
Sulfides	Positive	3½
	Trace	2
	Negative	0
Moisture	Poor drainage (continuous wet)	2
	Fair drainage (generally moist)	1
	Good drainage (generally dry)	0

* *If sulfides are present and low or negative redox-potentials results are obtained, add 3 points for this range.*

[6] American Water Works Association ANSI/AWWA C105/A21.5-05 Standard.

Based on a maximum possible score of 25½ using the AWWA method, the value of 10 for the use of corrosion protection, with a score of approximately 7 in the tested samples, the site soils appear to comprise a potentially moderately corrosive environment for buried metals.

If additional information is needed regarding soil corrosivity, the American Water Works Association or a Corrosion Engineer should be contacted. It should be noted, however, that changes to the site conditions during construction, such as the import of other soils, or the intended or unintended introduction of off-site water, may significantly alter corrosion potential.

PROJECT EARTHWORK

The earthwork criteria below are based on our interpretation of the geotechnical conditions encountered in the test holes. Where these criteria differ from applicable municipal specifications, e.g., for trench backfill compaction along a public utility line, the latter should be considered to take precedence.

General Considerations: Site grading should be performed as early as possible in the construction sequence to allow settlement of fills and surcharged ground to be realized to the greatest extent prior to subsequent construction.

Prior to earthwork construction, vegetation and other deleterious materials should be removed and disposed of off-site. Relic underground utilities should be abandoned in accordance with applicable regulations, removed as necessary, and properly capped.

Topsoil present on site should not be incorporated into ordinary fills. Instead, topsoil should be stockpiled during initial grading operations for placement in areas to be landscaped or for other approved uses.

Use of Existing Fill Soils: Fill materials were recognized in the test holes during subsurface exploration and are likely are present elsewhere on the site. Because not all the fill soils were sampled and tested, it is possible that some of the fill soils may not be suitable for re-use as compacted fill, due to the presence of deleterious materials such as trash, organic material, coarse cobbles and boulders, or construction debris. Therefore, excavated fill materials should be evaluated and tested, as appropriate, with regard to re-

use. Fragments of rock and cobbles larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills (see subsection below for additional discussion in this regard.

Use of Existing Native Soils: Overburden soils are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills. Fragments of rock and cobbles larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. Such fragments should not consist of non-durable sedimentary bedrock materials (i.e., siltstone, claystone, or sandstone bedrock). In general, such materials should be placed as deeply as possible in the project fills. A Geotechnical Engineer should be consulted regarding appropriate guidance for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard recommendations that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Imported Fill Materials: If it is necessary to import material to the site, the imported soils should be free of organic material, and other deleterious materials. **Imported material should consist of soils that have less than 35 percent passing the No. 200 Sieve and should have a plasticity index less than 10.** Representative samples of the materials proposed for import should be tested and approved prior to transport to the site.

CDOT Class 1 Structure Backfill: The criteria for CDOT Class 1 Structure Backfill are tabulated below.

CDOT CLASS 1 STRUCTURE BACKFILL

Sieve Size or Parameter	Acceptable Range
2-inch	100% passing
No. 4	30% to 100% passing
No. 50	10% to 60% passing
No. 200	5% to 20% passing
Liquid Limit	$\leq$ 35
Plasticity Index	$\leq$ 6

Materials proposed for import as structural fill should be approved prior to transport to the site.

Fill Platform Preparation: Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly compacted in accordance with the parameters below to provide a uniform base for fill placement. *If over-excavation is to be performed, then these parameters for subgrade preparation are also for the subgrade **below the bottom** of the specified over-excavation depth.*

If surfaces to receive fill expose loose, wet, soft or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

GROUND's experience within the project area suggests the frost depth to be approximately 3 feet, below ground surface.

Fill Placement: Fill materials should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted.

Soils that classify as GP, GW, GM, GC, SP, SW, SM, or SC in accordance with the USCS classification system (granular materials) should be compacted to **95 or more percent** of the maximum modified Proctor dry density at moisture contents **within 2 percent of optimum moisture content** as determined by ASTM D1557.

If encountered, soils that classify as ML, MH, CL or CH in accordance with the USCS classification system (cohesive materials) should be compacted to **98 percent** of the maximum dry density at moisture contents from **one percent below to 3 percent above the optimum moisture content** as determined by ASTM D698.

No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit significant pumping, rutting, and deflection at moisture contents near optimum

and above. The contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the suggested ranges are obtained.

Use of Squeegee: Relatively uniformly graded fine gravel or coarse sand, i.e., "squeegee," or similar materials commonly are proposed for backfilling foundation excavations, utility trenches (excluding approved pipe bedding), and other areas where employing compaction equipment is difficult. In general, GROUND does not suggest this procedure for the following reasons:

Although commonly considered "self-compacting," uniformly graded granular materials require densification after placement, typically by vibration. The equipment to densify these materials is not available on many job-sites.

Even when properly densified, granular materials are permeable and allow water to reach and collect in the lower portions of the excavations backfilled with those materials. This leads to wetting of the underlying soils and resultant potential loss of bearing support as well as increased local heave or settlement.

It is GROUND's opinion that wherever possible, excavations be backfilled with approved, site-derived fill soils placed as properly compacted fill. Where this is not feasible, use of "Controlled Low Strength Material" (CLSM), i.e., a lean, sand-cement slurry ("flowable fill") or a similar material for backfilling should be considered.

Where "squeegee" or similar materials are proposed for use by the contractor, the design team should be notified by means of a Request for Information (RFI), so that the proposed use can be considered on a case-by-case basis. Where "squeegee" meets the project requirements for pipe bedding material, however, it is acceptable for that use.

Settlements: Settlements will occur in filled ground, typically on the order of 1 to 2 percent of the fill depth. If fill placement is performed properly and is tightly controlled, in GROUND's experience the majority (on the order of 60 to 80 percent) of that settlement will typically take place during earthwork construction, provided the contractor achieves the compaction levels herein. The remaining potential settlements likely will take several

months or longer to be realized, and may be exacerbated if these fills are subjected to changes in moisture content.

Cut and Filled Slopes: Permanent site slopes supported by site soils up to 10 feet in height may be constructed no steeper than 3:1 (horizontal : vertical). Minor raveling or surficial sloughing should be anticipated on slopes cut at this angle until vegetation is well re-established. Surface drainage should be designed to direct water away from slope faces.

Steeper slope angles and heights may be possible but will require detailed slope stability analysis based on final proposed grading plans. A geotechnical engineer should be retained to evaluate this on a case-by-case basis.

EXCAVATION CONSIDERATIONS

Excavation Difficulty: Test holes for the subsurface exploration were advanced to the depths indicated on the test hole logs by means of conventional, truck-mounted, continuous flight solid-stem auger drilling equipment. Given the inherent nature of fill soils. Materials that may be awkward or otherwise difficult to handle (e.g., relatively large pieces of construction debris, cobbles, and boulders) may be encountered in the existing fill soils. The contractor and project team should be prepared to excavate, handle, and export such materials if encountered in the site soils. These materials should not be considered as an "unforeseen condition" at the time of construction.

In addition, relatively large cobbles and/or boulders may be encountered within the native soils as well. Again, the contractor and the project team should be prepared to excavate, handle, and possibly export such materials in the site soils.

Additionally, the site bedrock was generally very hard, especially with depth. Penetration resistance values of 50 blows for 2 inches of penetration encountered as shallowly as 8 feet below existing grade (Test Hole PP-3) and practical auger refusal was encountered at depths of approximately 6 and 14½ feet below existing grades in Test Holes PP-3 and PP-4. Still harder and more resistant layers of bedrock are present in the greater project area and likely will be encountered at the project site. The contractor and project team should anticipate some of the site bedrock will be very hard and require greater than typical efforts to excavate. Blasting or the use of a hydraulic hammer may be necessary to

excavate the site bedrock. Additionally, the use of coring or air-percussion equipment should be anticipated by the contractor and the project team to advance holes into the bedrock, though auger techniques may be feasible locally.

Groundwater Groundwater was encountered in Test Hole 1 at a depth of approximately 35 feet below existing grade. The test holes were backfilled upon completion of drilling operations per Code of Colorado Regulations (2 CCR 402-2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not comprise a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND should be contacted; additional exploration and fees will be necessary in this regard.

It is possible that groundwater may be encountered in project excavations at depths both shallower and deeper than those indicated above. The contractor should be prepared to dewater excavations during construction. Pumps adequate to discharge water and/or well points to draw down the water level may be appropriate methods. Other methods may also be necessary. The dewatering approach should ultimately be determined by the contractor based on their means and methods experience. Dewatering operations may be necessary as both temporary and long-term/permanent installations. If seepage or groundwater is encountered during excavation or at any time during construction, the Geotechnical Engineer and project team should be contacted to evaluate the conditions. The presence of groundwater in these types of situations and associated potential design changes can have an impact to both the financial and schedule components of a project.

Temporary Excavations and Personnel Safety Excavations in which personnel will be working must comply with all applicable OSHA Standards and Regulations, particularly CFR 29 Part 1926, OSHA Standards-Excavations, adopted March 5, 1990. The contractors “responsible person” should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. GROUND has provided the information in this report solely as a service to the Client and is not assuming responsibility for construction site safety or the contractor’s activities.

The contractor should take care when making excavations not to compromise the bearing or lateral support for any adjacent, existing improvements.

Temporary, un-shored excavation slopes up to 10 feet in height be cut no steeper than 1½:1 (horizontal : vertical) in the site soils in the absence of seepage. Some surface sloughing may occur on the slope faces at these angles. Local conditions encountered during construction, such as groundwater seepage and loose sand, will require flatter slopes. Stockpiling of materials should not be permitted closer to the tops of temporary slopes than 5 feet or a distance equal to the depth of the excavation, whichever is greater.

Should site constraints prohibit the use of the slope angles, temporary shoring should be used. The shoring should be designed to resist the lateral earth pressure exerted by buildings, improvements, traffic, equipment, stockpiles, etc.

Surface Water The contractor should take pro-active measures to control surface waters during construction and maintain good surface drainage conditions to direct waters away from excavations and into proper drainage structures. A properly designed drainage swale should be provided at the top of the excavations. In no case should water be allowed to pond at the site. Slopes should also be protected against erosion. Erosion along the slopes will result in sloughing and could lead to a slope failure.

UTILITY PIPE INSTALLATION AND BACKFILLING

The measures and criteria below are based on GROUND's evaluation of the local geotechnical conditions. Where the parameters herein differ from applicable municipal requirements, the latter should be considered to govern.

Pipe Support: The bearing capacity of the site soils appeared adequate, in general, for support of typical utility lines. The pipe + contents are anticipated to be less dense than the soils which will be displaced for installation. Therefore, in general GROUND anticipates no significant pipe settlements in these materials where properly bedded from loading alone.

Excavation bottoms may expose existing fill soils, soft, loose or otherwise deleterious materials. Firm materials may be disturbed by the excavation process. All such unsuitable materials should be excavated and replaced with properly compacted fill. Areas allowed

to pond water will require excavation and replacement with properly compacted fill. The contractor should take particular care to ensure adequate support near pipe joints which are less tolerant of extensional strains.

Where thrust blocks are needed, the parameters in the *Lateral Earth Pressures* section of this report may be used for design.

Trench Backfilling: Some settlement of compacted soil trench backfill materials should be anticipated, even where all the backfill is placed and compacted correctly. Typical settlements are on the order of 1 to 2 percent of fill thickness. However, the need to compact to the lowest portion of the backfill must be balanced against the need to protect the pipe from damage from the compaction process. Some thickness of backfill may need to be placed at compaction levels lower than specified (or smaller compaction equipment used together with thinner lifts) to avoid damaging the pipe. Protecting the pipe in this manner can result in somewhat greater surface settlements. Therefore, although other alternatives may be available, the following options are presented for consideration:

Controlled Low Strength Material: Because of these limitations, we suggest backfilling the entire depth of the trench (both bedding and common backfill zones) with "controlled low strength material" (CLSM), i.e., a lean, sand-cement slurry, "flowable fill," or similar material along all trench alignment reaches with low tolerances for surface settlements.

CLSM used as pipe bedding and trench backfill exhibit a 28-day unconfined compressive strength between 50 to 200 psi so that re-excavation is not unusually difficult.

Placement of the CLSM in several lifts or other measures likely will be necessary to avoid 'floating' the pipe. Measures also should be taken to maintain pipe alignment during CLSM placement.

Compacted Soil Backfilling: In areas that are tolerant of surface settlements, conventional soil backfilling may be used. Where compacted soil backfilling is employed, using the site soils or similar materials as backfill, the risk of backfill settlements entailed in the selection of this higher risk alternative must be anticipated and accepted by Jeffco Public Schools.

We anticipate that the site soils excavated from trenches will be suitable, in general, for use as common trench backfill within the above-described limitations. Backfill soils should

be free of vegetation, organic debris and other deleterious materials. Fragments of rock, cobbles, and inert construction debris (e.g., concrete or asphalt) coarser than 3 inches in maximum dimension should not be incorporated into trench backfills.

Soils placed for compaction as trench backfill should be conditioned to a relatively uniform moisture content, placed and compacted in accordance with the *Project Earthwork* section of this report.

Pipe Bedding: Pipe bedding materials, placement and compaction should meet the specifications of the pipe manufacturer and applicable municipal standards. Bedding should be brought up uniformly on both sides of the pipe to reduce differential loadings.

As discussed above, we suggest the use of CLSM or similar material in lieu of granular bedding and compacted soil backfill where the tolerance for surface settlement is low. (Placement of CLSM as bedding to at least 12 inches above the pipe can protect the pipe and assist construction of a well-compacted conventional backfill although possibly at an increased cost relative to the use of conventional bedding.)

If a granular bedding material is specified, it is our opinion that with regard to potential migration of fines into the pipe bedding, design and installation follow ASTM D2321. If the granular bedding does not meet filter criteria for the enclosing soils, then non-woven filter fabric (e.g., Mirafi® 140N, or the equivalent) should be placed around the bedding to reduce migration of fines into the bedding which can result in severe, local surface settlements. Where this protection is not provided, settlements can develop/continue several months or years after completion of the project. In addition, clay or concrete cut-off walls should be installed to interrupt the granular bedding section to reduce the rates and volumes of water transmitted along the sewer alignment which can contribute to migration of fines.

Additionally, If granular bedding is specified, the contractor should not anticipate that significant volumes of site soils will be suitable for that use. Materials proposed for use as pipe bedding should be tested by a geotechnical engineer for suitability prior to use. Imported materials should be tested and approved by a geotechnical engineer prior to transport to the site.

SURFACE DRAINAGE

The site soils are relatively stable with regard to moisture content – volume relationships at their existing moisture contents. Other than the anticipated, post-placement settlement of fills, post-construction soil movement will result primarily from the introduction of water into the soil underlying the proposed structure, hardscaping, and pavements. Based on the site surface and subsurface conditions encountered in this study, we do not anticipate a rise in the local water table sufficient to approach foundation or floor elevations. Therefore, wetting of the site soils likely will result from infiltrating surface waters (precipitation, irrigation, etc.), and water flowing along constructed pathways such as bedding in utility pipe trenches.

The following drainage measures should be incorporated as part of project design and during construction. The facility should be observed periodically to evaluate the surface drainage and identify areas where drainage is ineffective. Routine maintenance of site drainage should be undertaken throughout the design life of the proposed facility. If these measures are not implemented and maintained effectively, the movement estimates provided in this report could be exceeded.

1) Wetting or drying of the foundation excavations and underslab areas should be avoided during and after construction as well as throughout the improvements' design life. Permitting increases/variations in moisture to the adjacent or supporting soils may result in a decrease in bearing capacity, an increase in volume change of the underlying soils, and increased total and/or differential movements.

2) Measures for positive surface drainage away from the building should be provided and maintained to reduce water infiltration into foundation soils. Underdrains should not be relied upon in surface drainage design to collect and discharge surface waters.

   A minimum slope of **12 inches in the first 10 feet** should be incorporated in the areas not covered with pavement or concrete slabs. For areas covered with pavement or concrete slabs, increasing slopes to a minimum of **3 percent in the first 10 feet** will reduce, but not eliminate, the potential for moisture infiltration and subsequent volume change of underlying soils. Reducing the slopes to comply

with ADA requirements may be necessary by other design professionals but may entail an increased potential for moisture infiltration and subsequent volume change of the underlying soils and resultant distress.

In no case should water be allowed to pond near or adjacent to foundation elements, hardscaping, utility trench alignments, etc.

3) Drainage should be established and maintained to direct water away from sidewalks and other hardscaping as well as utility trench alignments. Where the ground surface does not convey water away readily, additional post-construction movements and distress should be anticipated.

The ground surface near foundation elements should be able to convey water away readily.

4) In GROUND's experience, it is common during construction that in areas of partially completed paving or hardscaping, bare soil behind curbs and gutters, and utility trenches, water is allowed to pond after rain or snow-melt events. Wetting of the subgrade can result in loss of subgrade support and increased settlements / increased heave. By the time final grading has been completed, significant volumes of water can already have entered the subgrade, leading to subsequent distress and failures. The contractor should maintain effective site drainage throughout construction so that water is directed into appropriate drainage structures.

5) On some sites, slopes may descend toward buildings locally. Such slopes can be created during grading even on comparatively flat sites. In such cases, even where the slopes as described above are implemented effectively, water may flow toward and beneath a structure or other site improvements with resultant additional, post-construction movements. Where the final site configuration includes graded or retained slopes descending toward the improvements, surface drainage swales and/or interceptor drains should be installed between the improvements and the slope.

Where irrigation is applied on or above slopes, drainage structures commonly are needed near the toe-of-slope to prevent on-going or recurrent wet conditions.

6) Roof downspouts and drains, if used, should discharge well beyond the perimeter of the structure foundations (minimum 10 feet) and backfill zones and be provided with positive conveyance off-site for collected waters. Downspouts should not be routed to discharge into an underdrain system.

If roof downspouts and drains are not used, then surface drainage design should anticipate concentrated volumes of water adjacent to the building.

7) Based on our experience with similar facilities, the project may include landscaping/watering near site improvements. Irrigation water – both that applied to landscaped areas and over-spray – is a significant cause of distress to improvements.

To reduce the potential for such distress, vegetation requiring watering should be located **10 or more feet** from the building perimeter, flatwork, or other improvements. Irrigation sprinkler heads should be deployed so that applied water is not introduced near or into foundation/subgrade soils. Landscape irrigation should be limited to the minimum quantities necessary to sustain healthy plant growth.

Use of drip irrigation systems can be beneficial for reducing over-spray beyond planters. Drip irrigation can also be beneficial for reducing the amounts of water introduced to foundation/subgrade soils, but only if the total volumes of applied water are controlled with regard to limiting that introduction. Controlling rates of moisture increase beneath the foundations, floors, and other improvements should take higher priority than minimizing landscape plant losses.

Where plantings are desired within 10 feet of a building, plants should be placed in water-tight planters, constructed either in-ground or above-grade, to reduce moisture infiltration in the surrounding subgrade soils. As an alternative involving a limited increase in risk, the use of water-tight planters may be replaced by local shallow underdrains beneath the planter beds. Colorado Geological Survey – Special Publication 43 provides additional guidelines for landscaping and reducing the amount of water that infiltrates into the ground.

GROUND understands many municipalities require landscaping within 10 feet of building perimeters. Provided that positive, effective surface drainage is initially implemented and maintained throughout the life of the facility and the Owner understands and accepts the risks associated with this requirement, vegetation that requires little to no watering may be located within 10 feet of the building perimeter.

Inspections must be made by facility representatives to make sure that the landscape irrigation is functioning properly throughout operation and that excess moisture is not applied.

8) Plastic membranes should not be used to cover the ground surface adjacent to the building without careful consideration of other components of project drainage. Plastic membranes can be beneficial to directing surface waters away from the building and toward drainage structures; however, they effectively preclude evaporation and transpiration of shallow soil moisture. Therefore, soil moisture tends to increase beneath these membranes. Perforated "weed barrier" membranes that allow ready evaporation from the underlying soils may be used.

   Cobbles or other materials that tend to act as baffles and restrict surface flow should not be used to cover the ground surface near the foundations.

9) Maintenance as described herein may include complete removal and replacement of site improvements in order to maintain effective surface drainage.

SUBSURFACE DRAINAGE

As a component of project civil design, properly functioning, subsurface drain systems (underdrains) can be beneficial for collecting and discharging saturated subsurface waters. Underdrains will not collect water infiltrating under unsaturated (vadose) conditions, or moving via capillarity, however. In addition, if not properly constructed and maintained, underdrains can transfer water into foundation soils, rather than remove it. This will tend to induce heave or settlement of the subsurface soils, and may result in distress. Underdrains can, however, provide an added level of protection against relatively severe post-construction movements by draining saturated conditions near individual structures should they arise, and limiting the volume of wetted soil.

Although inclusion of an underdrain system is common on school sites like the subject facility, particularly where shallow foundations are used, professional opinion varies regarding the potential benefits relative to the cost. It is GROUND's opinion that it will be beneficial to include a perimeter underdrain system to help limit wetting of the foundation bearing soils; however, we understand that Jeffco Public Schools and project team may consider the reduction of risk provided by a properly constructed and maintained underdrain system does not justify the costs associated with including an underdrain. In such a case, an underdrain system can be excluded. If an underdrain system is excluded, then there will be an increased risk of the post-construction movements estimated in this report being exceeded. GROUND considers this risk to be low, but it is not zero. Where an underdrain system is excluded, extra care should be taken to establish and maintain effective surface drainage, identify and repair wet utility leaks in a timely manner, seal open cracks, joints, and restore effective surface drainage as necessary to limit the volume of water infiltrating the site.

If the existing building has an underdrain system, underdrain systems should be installed beneath the additions.

If below-grade or partially below-grade level(s) are added to the building, then we recommend that an underdrain system be included. Damp-proofing should be applied to the exteriors of below-grade elements. The provision of Tencate MiraFi® G-Series backing (or comparable wall drain provisions) on the exteriors of (some) below-grade elements may be appropriate, depending on the intended use. If a (partially) below-grade level is limited in extent, the underdrain system, etc., may be local to that area.

As discussed, grades descend inward toward the site from the south, west, and north. The classroom addition will be located relatively close to the slopes that descend south from Evergreen Parkway. The site grades should be properly designed, constructed, and maintained to properly drain. An interceptor drain should be considered to be installed between the slope and the classroom building addition.

Geotechnical Parameters for Underdrain Design Where an underdrain system is included in project drainage design, it should be designed in accordance with the recommendations below. The actual underdrain layout, outlets, and locations should be

developed by a civil engineer. Typical underdrain details are provided in Figure 6 and Figure 7.

An underdrain system should be tested by the contractor after installation and after placement and compaction of the overlying backfill to verify that the system functions properly.

1) An underdrain system for a building should consist of perforated, rigid, PVC collection pipe at least 4 inches in diameter, non-perforated, rigid, PVC discharge pipe at least 4 inches in diameter, free-draining gravel, and filter fabric, as well as a waterproof membrane.

2) The free-draining gravel should be naturally occurring (not recycled) material with less than 5 percent passing the No. 200 Sieve, more than 50 percent retained on the No. 4 Sieve, and have a maximum particle size of 2 inches. Each collection pipe should be surrounded on the sides and top (only) with 6 or more inches of free-draining gravel.

3) The gravel surrounding the collection pipe(s) should be wrapped with filter fabric (MiraFi 140N® or the equivalent) to reduce the migration of fines into the drain system.

4) The waterproof membrane should underlie the gravel and pipe, and be attached to the foundation grade beam or stem wall.

5) The underdrain system should be designed to discharge at least 10 gallons per minute of collected water.

6) The high point(s) for the collection pipe flow lines should be below the shallow foundation bearing elevation. Multiple high points can be beneficial to reducing the depths to which the system would be installed.

   The collection and discharge pipe for the underdrain system should be laid on a slope sufficient for effective drainage, but a minimum of 1 percent. (Flatter gradients may be used but will convey water less efficiently and entail an increased risk of local post-construction movements.)

Pipe gradients also should be designed to accommodate at least 1 inch of differential movement after installation along a 50-foot run.

7) Underdrain 'clean-outs' should be provided at intervals of no more than 100 feet to facilitate maintenance of the underdrains. Clean-outs also should be provided at collection and discharge pipe elbows of 60 degrees or more.

8) The underdrain discharge pipes should be connected to one or more sumps from which water can be removed by pumping, or to outlet(s) for gravity discharge. We suggest that collected waters be discharged directly into the storm sewer system, if possible.

Interceptor Drains Ground surfaces sloped toward a building can lead to increased infiltration of surface waters into the foundation soils. The actual interceptor drain layout, outlets, and locations should be developed by a civil engineer. A typical, cross-section detail of an interceptor for this project is provided on Figure 8.

Geotechnical Parameters for Interceptor Drain Design Where an interceptor drain is included in project drainage design, it may be designed in accordance with the recommendations above for an underdrain system, but as modified below.

1) The high point(s) of collection pipes should be 5 or more feet below finished grades. Multiple high points may be beneficial to reducing the depths to which the system would be installed.

2) The top of the gravel section should extend to within about 1 foot of finished grades.

3) The slopes of the collection and discharge pipes for the interceptor drain system generally should mimic surface gradients, but should be sufficient for effective drainage and at least 1 percent. (Flatter gradients may be used but will convey water less efficiently and entail an increased risk of local post-construction movements.)

4) No waterproof membrane is needed as a component of an interceptor drain system.

5) The interceptor system should be designed to discharge at least 20 gallons per minute of collected water.

PAVEMENT SECTIONS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. The standard care of practice in pavement design describes the flexible pavement section as a "20-year" design pavement: however, most flexible pavements will not remain in satisfactory condition without routine maintenance and rehabilitation procedures performed throughout the life of the pavement. Pavement designs for the private pavements were developed in general accordance with the design guidelines and procedures of the American Association of State Highway and Transportation Officials (AASHTO) and local pavement construction practice.

Subgrade Materials Based on the results of our field exploration and laboratory testing, the potential pavement subgrade materials classify predominantly as A-1-b to A-4 in accordance with the American Association of State Highway and Transportation Officials (AASHTO) classification system. The pavement subgrade materials are anticipated to consist of silty to clayey sands and silty to clayey sands with gravels. Such soils generally provide good subgrade support for pavements.

Based on our experience with similar projects, a resilient modulus value of 8,000 psi was estimated for the site soils. It is important to note that significant decreases in soil support have been observed as the moisture content increases above the optimum. Pavements that are not properly drained may experience a loss of the soil support and subsequent reduction in pavement life.

Anticipated Traffic Traffic data for the proposed facility was unavailable at the time of our report preparation. Based on our experience with similar projects, equivalent 18-kip daily load application (EDLA) values of 3, 10, and 50 were assumed for the general parking areas, drive lanes, and heavy truck traffic areas, respectively. The EDLA values of 3, 10, and 50 were converted to equivalent 18-kip single axle load (ESAL) values of 21,900, 73,000, and 365,000 for a 20-year design life, respectively. If anticipated traffic loadings differ significantly from these assumed values, GROUND should be notified to re-evaluate the pavement sections below

Pavement Design The estimated soil resilient modulus and the ESAL values were used to determine the required design structural number for the project pavements. The required structural number was then used to develop the pavement sections. Pavement designs were based on the DARWin™ computer program that solves the 1993 AASHTO pavement design equations. A reliability level of 85 percent and a terminal serviceability of 2 were utilized for design of the pavement sections. A structural coefficient of 0.44 was used for hot bituminous asphalt and 0.12 was used for aggregate base course. The minimum pavement sections for a 20-year design are tabulated below.

MINIMUM PAVEMENT SECTIONS

Location	**Flexible Section** *(inches Asphalt)*	**Composite Section** *(inches Asphalt / inches Aggregate Base)*	**Rigid Section** *(inches Concrete / inches Aggregate Base)*
General Parking Stalls	5½	4 / 6	6 / 6
Drive Lanes	6½	4½ / 8	6 / 6
Heavy Truck Traffic Areas, Fire Lanes, and Bus Lanes	-	5½ / 10	7 / 6

In our experience, asphalt pavements will not perform as well as rigid pavement in areas of high turning stresses or prolonged static loading. Trash collection areas, as well as other pavement areas subjected to high turning stresses or heavy truck traffic be provided with rigid pavements consisting of Portland cement concrete (see table above). The owner should consider reinforced concrete in these areas. Although not required to meet the design structural number, increasing the thickness of aggregate base course material beneath pavement sections, particularly at facility entrances/exits and heavy traffic areas, is anticipated to enhance performance of the site pavements.

Asphalt pavement should consist of a bituminous plant mix composed of a mixture of aggregate and bituminous material. Asphalt mixture(s) should meet the requirements of a job-mix formula established by a qualified Engineer.

Concrete pavements should consist of a plant mix composed of a mixture of aggregate, Portland cement and appropriate admixtures meeting the requirements of a job-mix formula established by a qualified engineer. Concrete should have a minimum modulus of rupture of third point loading of 650 psi. Normally, concrete with a 28-day compressive

strength of 4,000 psi should develop this modulus of rupture value. The concrete should be air-entrained with approximately 6 percent air and should have a minimum cement content of 6 sacks per cubic yard. Maximum allowable slump should be 4 inches.

In areas of repeated turning stresses the concrete pavement joints should be fully tied or doweled. We suggest that civil design consider joint layout in accordance with CDOT's M Standards. Standard plans for placement of ties and dowels, etc., (CDOT M Standards) for concrete pavements can be found at the CDOT website.

If composite flexible sections are placed, the aggregate base material should meet the criteria of CDOT Class 6 aggregate base course. Base course should be placed in uniform lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of the maximum dry density a uniform moisture contents within 2 percent of the optimum as determined by ASTM D1557 / AASHTO T-180, the "modified Proctor."

Subgrade Preparation Remedial earthwork to any depth will not prevent pavement distress on these soils, but will tend to reduce it and improve perceived rideability. If performance like project floors is desired, then project pavements should be constructed in a similar manner as project floors.

Remedial Earthwork Where undocumented fill soils are present beneath proposed pavement areas, all of the fill soils should be removed and replaced as properly compacted fill.

We understand, however, that it may not be practical remove and replace the undocumented fill soils to their full depths or soft, yielding, or otherwise deleterious soils as properly compacted fill due the presence of utility lines and the proximity of existing improvements. Therefore, if the owner opts to reduce the fill section beneath the pavements, additional post-construction movements, accelerated pavement distress, and additional maintenance should be anticipated. We suggest remedial earthwork should be performed to no less than 12 inches in such a case. Similarly, where existing utility lines or other site constraints limit the depth to which remedial earthwork can be accomplished, additional maintenance should be anticipated.

Based on CDOT guidelines and the risk of settlement at the site, the pavements should be constructed on a section of properly moisture-conditioned and compacted soils to a

depth of **at least 12 inches or a depth that removes and replaces all of the undocumented fill soils, whichever greater**. These sections assume that a) traffic speeds in the parking areas and driveways will be relatively slow, and b) the facility owner will be tolerant of significant total and differential pavement post-construction movements (on the order of several inches) and the associated maintenance costs that that are necessary to re-establish effective drainage, replace distressed pavement, etc.

Subgrade preparation of the selected depth should extend the full width of the pavement from back-of-curb to back-of-curb. The subgrade for any sidewalks and other project hardscaping also should be prepared in the same manner.

Geotechnical criteria for fill placement and compaction are provided in the *Project Earthwork* section of this report. The contractor should be prepared to either dry the subgrade materials or moisten them, as needed, prior to compaction.

Proof Rolling Immediately prior to paving, the subgrade should be proof rolled with a heavily loaded, pneumatic tired vehicle. Areas that show excessive deflection during proof rolling should be excavated and replaced and/or stabilized. Areas allowed to pond prior to paving will require significant re-working prior to proof-rolling. Establishment of a firm paving platform (as indicated by proof rolling) is an additional requirement beyond proper fill placement and compaction. It is possible for soils to be compacted within the limits indicated in the *Project Earthwork* section of this report and fail proof rolling, particularly in the upper range of moisture content.

Additional Observations The collection and diversion of surface drainage away from paved areas is extremely important to the satisfactory performance of the pavements. The subsurface and surface drainage systems should be carefully designed to ensure removal of the water from paved areas and subgrade soils. Allowing surface waters to pond on pavements will cause premature pavement deterioration. Where topography, site constraints, or other factors limit or preclude adequate surface drainage, pavements should be provided with edge drains to reduce loss of subgrade support. The long-term performance of the pavement also can be improved greatly by proper backfilling and compaction behind curbs, gutters, and sidewalks so that ponding is not permitted and water infiltration is reduced.

Landscape irrigation in planters adjacent to pavements and in "island" planters within paved areas should be carefully controlled or differential heave and/or rutting of the nearby pavements will result. Drip irrigation systems are suggested for such planters to reduce over-spray and water infiltration beyond the planters. Enclosing the soil in the planters with plastic liners and providing them with positive drainage also will reduce differential moisture increases in the surrounding subgrade soils. In our experience, infiltration from planters adjacent to pavements is a principal source of moisture increase beneath those pavements. This wetting of the subgrade soils from infiltrating irrigation commonly leads to loss of subgrade support for the pavement with resultant accelerating distress, loss of pavement life and increased maintenance costs. This is particularly the case in the later stages of project construction after landscaping has been emplaced but heavy construction traffic has not ended. Heavy vehicle traffic over wetted subgrade commonly results in rutting and pushing of flexible pavements, and cracking of rigid pavements. In relatively flat areas where design drainage gradients necessarily are small, subgrade settlement can obstruct proper drainage and yield increased infiltration, exaggerated distress, etc. (These considerations apply to project flatwork, as well.)

As noted above, the standard care of practice in pavement design most often describes the flexible pavement section as a "20-year" design pavement and the rigid pavement section as a "30-year" pavement; however, most pavements will not remain in satisfactory condition without routine, preventive maintenance and rehabilitation procedures performed throughout the life of the pavement. Preventive pavement treatments are surface rehabilitation and operations applied to improve or extend the functional life of a pavement. These treatments preserve, rather than improve, the structural capacity of the pavement structure. In the event the existing pavement is not structurally sound, the preventive maintenance will have no long-lasting effect. Therefore, a routine maintenance program to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavement is suggested.

A crack sealing and fog seal/chip seal program should be performed on the pavements every 3 to 4 years. After approximately 8 to 10 years, patching, additional crack sealing, and asphalt overlay may be required. Prior to future overlays, it is important that all transverse and longitudinal cracks be sealed with a flexible, rubberized crack sealant in order to reduce the potential for propagation of the crack through the overlay. Traffic volumes that exceed the values utilized by this report will likely necessitate the need of

pavement maintenance practices on a schedule of shorter timeframe than that stated above. The greatest benefit of preventive maintenance is achieved by placing the treatments on sound pavements that have little or no distress.

GROUND's experience indicates that longitudinal cracking is common in asphalt-pavements generally parallel to the interface between the asphalt and concrete structures such as curbs, gutters or drain pans. Distress of this type is likely to occur even where the subgrade has been prepared properly and the asphalt has been compacted properly. The use of thick base course or reinforced concrete pavement can reduce this. Our office should be contacted if these alternates are desired.

The assumed traffic loading does not include excess loading conditions imposed by heavy construction vehicles. Consequently, heavily loaded concrete, lumber, and building material trucks can have a detrimental effect on the pavement. An effective program of regular maintenance should be developed and implemented to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavements.

EXTERIOR FLATWORK

We understand portions of the site will be provided with concrete flatwork. Like other site improvements, flatwork will experience post-construction movements as soil moisture contents increase after construction and distress likely will result. The following measures will help to reduce damages to these improvements, but will not prevent all movements. Critical flatwork, which may include flatwork at entrances and exits, should be constructed as a reinforced slab-on-grade floor in a similar manner to project floors. Areas desired for limited post-construction movements should be structurally supported. Such areas should be identified by Jeffco Public Schools.

1) Remedial earthwork to prepare flatwork subgrades is subject to the same factors discussed in the *Pavement Sections* section of this report, and should be undertaken to the same depth.

   Regardless of the depth of subgrade preparation, due to the presence of undocumented fill at this site, greater than typical maintenance, including the removal and replacement of portions of flatwork, should be anticipated for project

exterior flatwork. Greater depths of subgrade preparation will tend to reduce the extent and frequency of extra maintenance, however.

2) Prior to placement of flatwork, a proof roll should be performed to identify areas that exhibit instability and deflection. The deleterious soils in these areas should be removed and replaced with properly compacted fill. The contractor should take care to achieve and maintain compaction behind curbs to reduce differential sidewalk settlements. Passing a proof roll is an additional requirement to placing and compacting the subgrade fill soils within the specified ranges of moisture content and relative compaction in the *Project Earthwork* section of this report. Subgrade stabilization may be cost-effective in this regard.

3) Flatwork should be provided with control joints extending to an effective depth and spaced no more than **10 feet** apart, both ways. Narrow flatwork, such as sidewalks, likely will require more closely spaced joints.

4) In no case should exterior flatwork extend to under any portion of the building where there is less than **2 inches** of vertical clearance between the flatwork and any element of the building. Exterior flatwork in contact with brick, rock facades, or any other element of the building can cause damage to the structure if the flatwork experiences movements.

Construction and Drainage Between Buildings and Pavements Proper design, drainage, construction and maintenance of the areas between individual buildings and parking/driveway areas are critical to the satisfactory performance of the project. Sidewalks, entranceway slabs and roofs, fountains, raised planters and other highly visible improvements commonly are installed within these zones, and distress in or near these improvements is common. Commonly, proper soil preparation in these areas receives little attention during overlot construction because they fall between the building and pavement areas which typically are built with heavy equipment. Subsequent landscaping and hardscape installation often is performed by multiple sub-contractors with light or hand equipment, and necessary over-excavation and soil processing is not performed. Consequently, subgrade soil conditions commonly deviate significantly from specified ranges. Therefore, the contractor should take particular care with regard to proper subgrade preparation in the immediate building exteriors.

Concrete Scaling Climatic conditions in the project area including relatively low humidity, large temperature changes and repeated freeze – thaw cycles, make it likely that project sidewalks and other exterior concrete will experience surficial scaling or spalling. The likelihood of concrete scaling can be increased by poor workmanship during construction, such as 'over-finishing' the surfaces. In addition, the use of de-icing salts on exterior concrete flatwork, particularly during the first winter after construction, will increase the likelihood of scaling. Even use of de-icing salts on nearby roadways, from where vehicle traffic can transfer them to newly placed concrete, can be sufficient to induce scaling. Typical quality control / quality assurance tests that are performed during construction for concrete strength, air content, etc., do not provide information with regard to the properties and conditions that give rise to scaling.

We understand that some municipalities require removal and replacement of concrete that exhibits scaling, even if the material was within specification and placed correctly. The contractor should be aware of the local requirements and be prepared to take measures to reduce the potential for scaling and/or replace concrete that scales.

In GROUND's experience, the measures below can be beneficial for reducing the likelihood of concrete scaling. Which measures, if any, used should be based on cost and the owner's tolerance for risk and maintenance. It must be understood, however, that because of the other factors involved, including weather conditions and workmanship, surface damage to concrete can develop, even where all of these measures were followed. Also, the mix design criteria should be coordinated with other project requirements including criteria for sulfate resistance presented in the *Water-Soluble Sulfates* section of this report.

1) Maintaining a maximum water/cement ratio of 0.45 by weight for exterior concrete mixes.

2) Include Type F fly ash in exterior concrete mixes as 20 percent of the cementitious material.

3) Specify a minimum, 28-day, compressive strength of 4,500 psi for all exterior concrete.

4) Including 'fibermesh' in the concrete mix also may be beneficial for reducing surficial scaling.

5) Cure the concrete effectively at uniform temperature and humidity. This commonly will require fogging, blanketing and/or tenting, depending on the weather conditions. As long as 3 to 4 weeks of curing may be required, and possibly more.

6) Avoid placement of concrete during cold weather so that it is not exposed to freeze-thaw cycling before it is fully cured.

7) Avoid the use of de-icing salts on given reaches of flatwork through the first winter after construction.

We understand that sometimes it is not practical to implement some of these measures for reducing scaling due to safety considerations, project scheduling, etc. In such cases, where these measures are not implemented, additional costs for flatwork maintenance or reconstruction should be incorporated into project budgets.

Frost and Ice Considerations Nearly all soils other than relatively coarse, clean, granular materials are susceptible to loss of density if allowed to become saturated and exposed to freezing temperatures and repeated freeze – thaw cycling. The formation of ice in the underlying soils can result in heaving of pavements, flatwork, and other hardscaping ("ice jacking") in sustained cold weather up to 2 inches or more. This heaving can develop relatively rapidly. A portion of this movement typically is recovered when the soils thaw, but due to loss of soil density, some degree of displacement will remain. This can result even where the subgrade soils were prepared properly.

Where hardscape movements are a design concern, e.g., at doorways, replacement of the subgrade soils with 3 or more feet of clean, coarse sand or gravel should be considered or supporting the element on foundations similar to the building and spanning over a void. Detailed guidance in this regard can be provided upon request. It should be noted that where such open graded granular soils are placed, water can infiltrate and accumulate in the subsurface relatively easily, which can lead to increased settlement or heave from factors unrelated to ice formation. Therefore, where a section of open graded

granular soils are placed, a local underdrain system should be provided to discharge collected water. GROUND will be available to discuss these concerns upon request.

TEMPORARY FIRE TRUCK ACCESS

Commonly, construction sites are required by local fire departments to provide temporary access for emergency response. It has been GROUND's experience these access drives are to provide support for trucks weighing up to 90,000 pounds and are typically desired to be gravel/aggregate-surfaced.

Based on our experience, a temporary section consisting of at least 12 inches of material meeting the requirements of CDOT Class 5 or Class 6 Aggregate Base Course or at least 8 inches of CDOT Class 5 or Class 6 Aggregate Base Course over a layer of stabilization geotextile/geofabric, such as Mirafi® RS380*i* or the equivalent, could be utilized provided the Owner understands that this section is for temporary access during construction only and is not a replacement or an equal alternate to the pavement section(s) that was indicated previously. The aggregate base course placed for this purpose should be compacted to at least 95 percent of the maximum modified Proctor dry density. It should be noted that the aggregate base course sections indicated above are not intended to support fire truck outriggers without cribbing or similar measures.

It should be understood that with any aggregate surface, shoving and displacement of the granular materials should be expected during repetitive vehicular/equipment loading. Therefore, regular maintenance should be implemented to ensure proper surface and subsurface drainage, repair distressed/damaged areas, and re-establish grades. Application of additional aggregate may be required in this regard. Additionally, the ability of the aggregate temporary access drive to accommodate loads as indicated above is directly related to the quality of the subgrade materials on which the aggregate is placed, not only on the aggregate section. If water infiltrates these areas, additional rutting and other distress, including a reduction in capacity, will result, requiring additional maintenance.

CLOSURE

Geotechnical Review The author of this report or a GROUND principal should be retained to review project plans and specifications to evaluate whether they comply with

the intent of the measures discussed in this report. The review should be requested in writing.

The geotechnical conclusions and parameters presented in this report are contingent upon observation and testing of project earthwork by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the parameters in this report, or by providing alternative parameters.

Materials Testing Jeffco Public Schools should consider retaining a geotechnical engineer to perform materials testing during construction. The performance of such testing or lack thereof, however, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of his work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services that he deems necessary to complete the project in accordance with applicable documents.

Limitations This report has been prepared for Jeffco Public Schools as it pertains to design of the proposed additions and improvements to the Bergen Valley Elementary School facility, as described herein. It should not be assumed to contain sufficient information for other parties or other purposes. The Client has agreed to the terms, conditions, and liability limitations outlined in our proposal between Jeffco Public Schools and GROUND.

In addition, GROUND has assumed that project construction will commence by spring 2024 and end within 1 year of the project commencement date. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this report may be re-evaluated and, as necessary, modified. **If our described understanding/interpretation of the proposed project is incorrect or project elements differ in any way from that expressed herein, including additional buildings/structures, changes to improvement locations, dimensions, structural loading, site improvements, grades, etc., and are incorporated into this project, either after the original information was provided to us or after the date of**

this report, GROUND must be notified to re-evaluate the conclusions and parameters presented herein.

The geotechnical conclusions and parameters in this report were based on subsurface information from a limited number of exploration points, as shown in *Figure 1*, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration. Design modifications may be necessary by the project team; this may result in an increase in project costs and schedule delays. In addition, a contractor who obtains information from this report for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes, but is not limited to, information regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, work should cease and a geotechnical engineer should be retained at once, so that our conclusions and design parameters for this site may be re-evaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials present on site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed structure and pavement will depend on implementation of the conclusions and information in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will

exceed estimates provided herein and should therefore be expected by Jeffco Public Schools.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed improvements are understood by Jeffco Public Schools. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this report by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that Jeffco Public Schools contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks and remedial approaches presented in this report, as well as other potential approaches, upon request.

Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect**.**

This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide Jeffco Public Schools with a proposal for construction observation and materials testing.

Sincerely,

GROUND Engineering Consultants, Inc.

Brian J. Knecht, P.G.

Reviewed by Jason A. Smith, REM, P.E.

GOOGLE EARTH AERIAL IMAGE (06/10/2021)

RW4 Indicates test hole numbers and approximate locations.

P-4 Indicates test hole drilled on separate job.

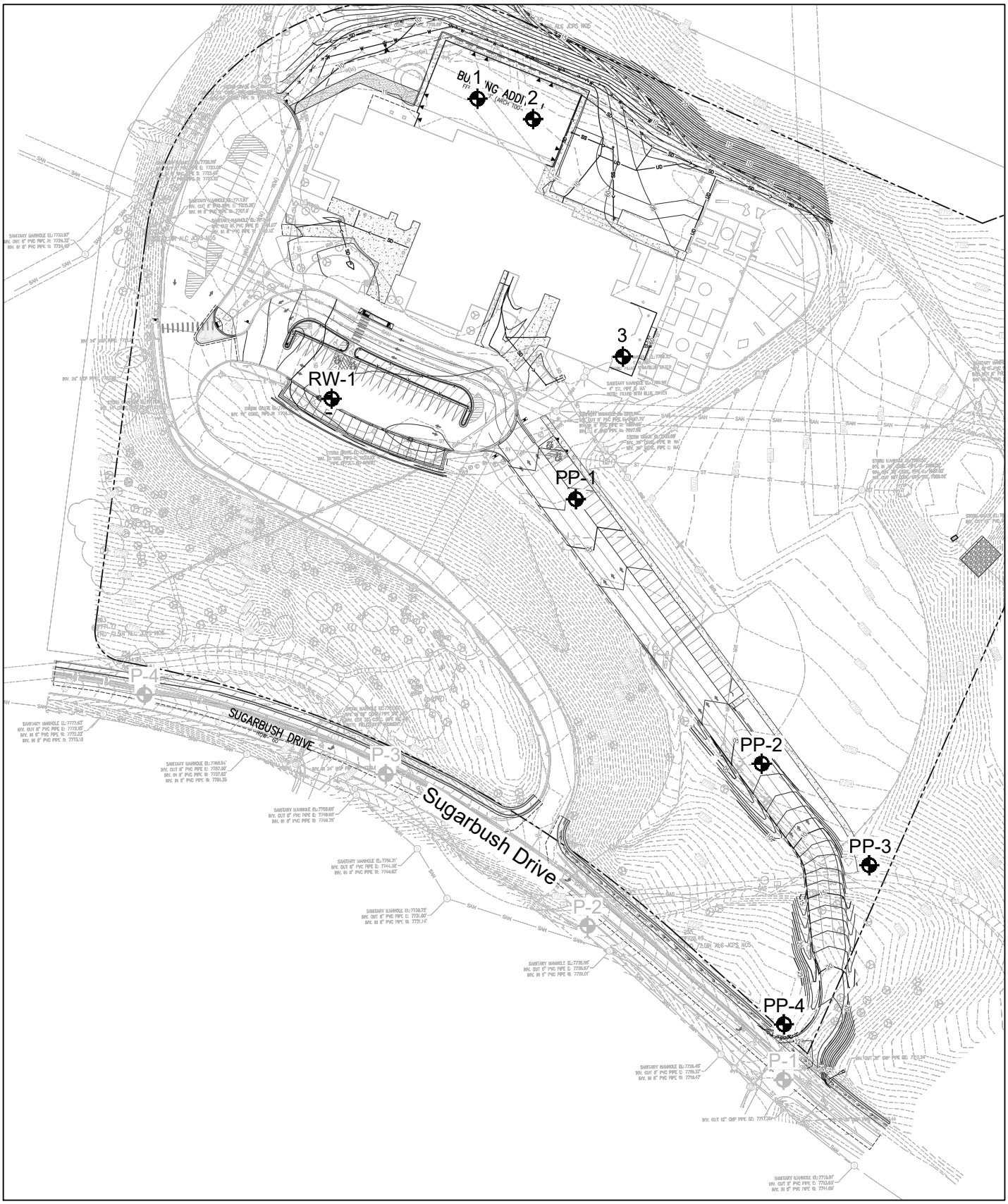
NOT TO SCALE

GROUND ENGINEERING

JOB NO.: 22-3677

FIGURE: 1A

LOCATION OF TEST HOLES



RW4
Indicates test hole numbers and approximate locations.

P-4
Indicates test hole drilled on separate job.

NOT TO SCALE

SITE PLAN PROVIDED BY CLIENT

GROUND ENGINEERING

JOB NO.: 22-3677

FIGURE: 1B

LOCATION OF TEST HOLES

GROUND ENGINEERING

LOGS OF THE TEST HOLES

CLIENT: Jeffco Public Schools

JOB NO: 22-3677A

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

PROJECT LOCATION: Evergreen, CO

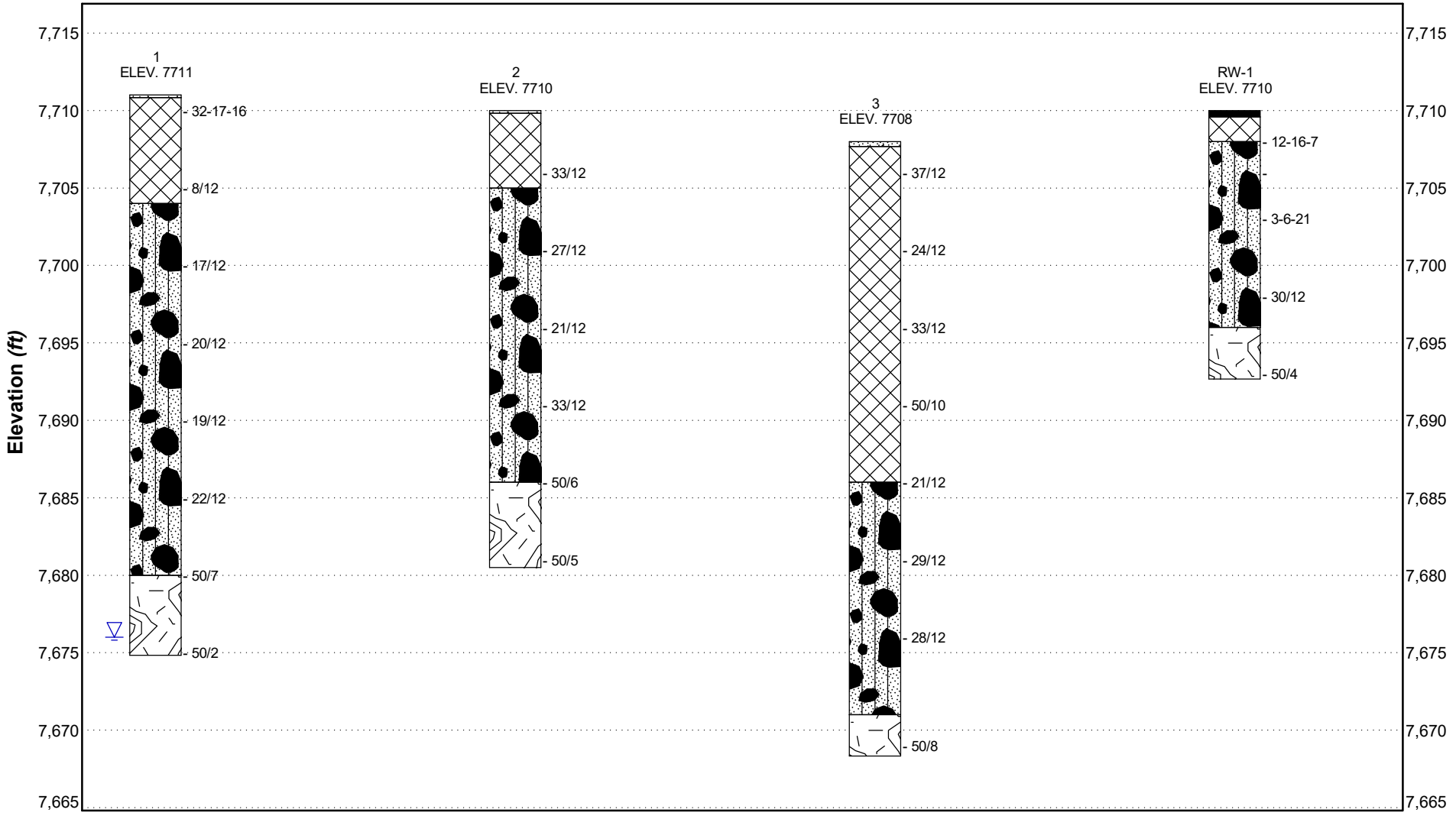


FIGURE: 2

GROUND ENGINEERING

LOGS OF THE TEST HOLES

CLIENT: Jeffco Public Schools

JOB NO: 22-3677A

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

PROJECT LOCATION: Evergreen, CO

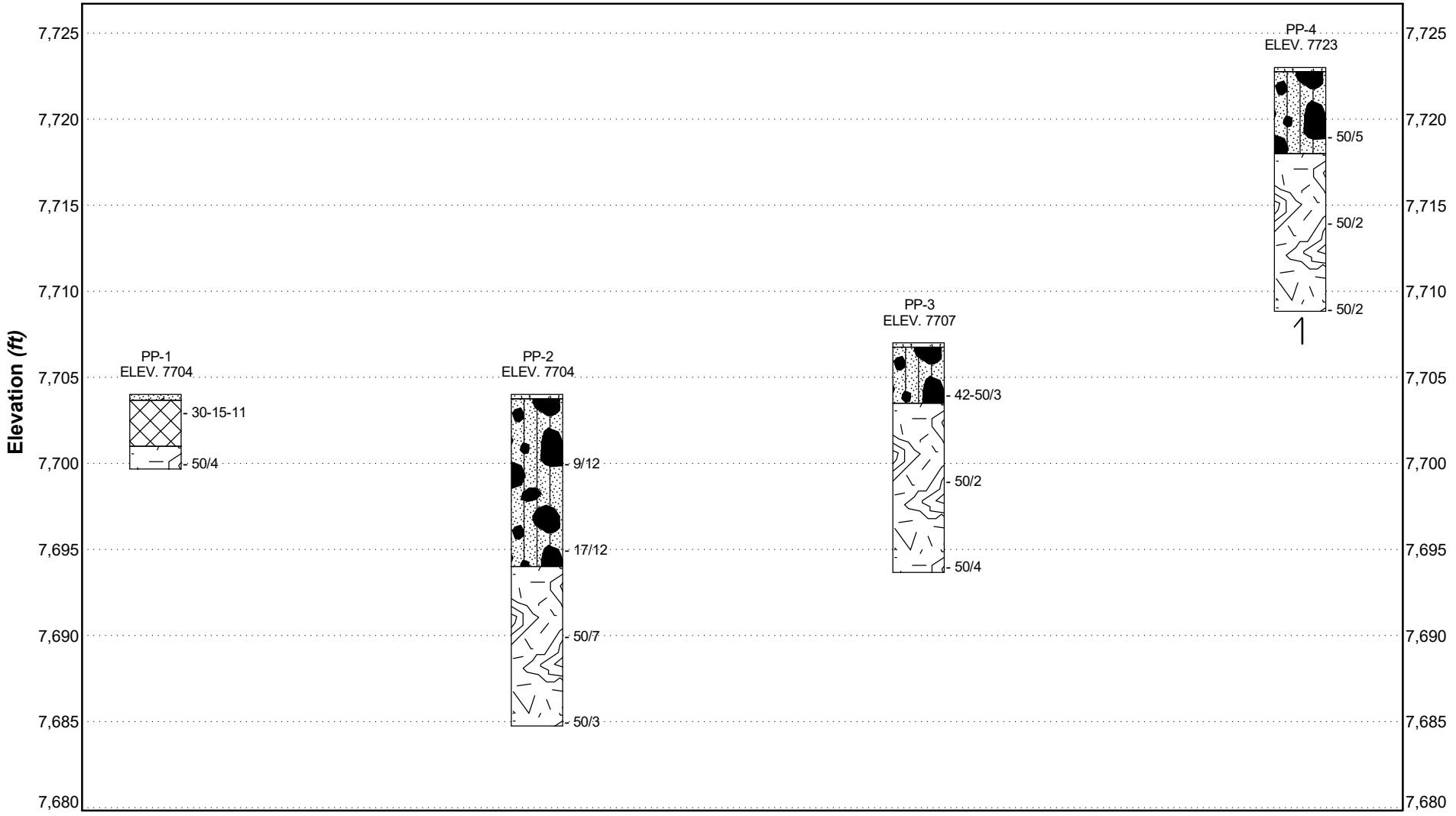


FIGURE: 3

LEGEND AND NOTES

CLIENT: Jeffco Public Schools
PROJECT NAME: Bergen Valley ES - Additions and Site Improvements
JOB NO: 22-3677A
PROJECT LOCATION: Evergreen, CO

MATERIAL SYMBOLS

ASPHALT

CONCRETE

TOPSOIL

ROAD BASE

FILL

Silty to Clayey SANDS with Gravel

GNEISS Bedrock

NOTE: See Detailed Logs for Material descriptions.

SAMPLER SYMBOLS

Modified California Liner Sampler
23 / 12 Drive sample blow count indicates 23 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 12 inches.

No Recovery

Standard Penetration Test Sampler
20-25-30 Drive sample blow count, indicates 20, 25, and 30 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 18 inches in three 6 inch increments.

NOTES

1. Test holes were drilled on 1/31/2023 & 2/20/2023 with 4" Solid Stem Auger.

2. Locations of the test holes were determined approximately by pacing from features shown on the site plan provided.

3. Elevations of test holes were estimated from client provided documents and the logs of test holes are hung to elevation.

4. The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

5. The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

6. Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.

7. The material descriptions on these logs are for general classification purposes only. See full text of this report for descriptions of the site materials & related information.

8. All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

ABBREVIATIONS

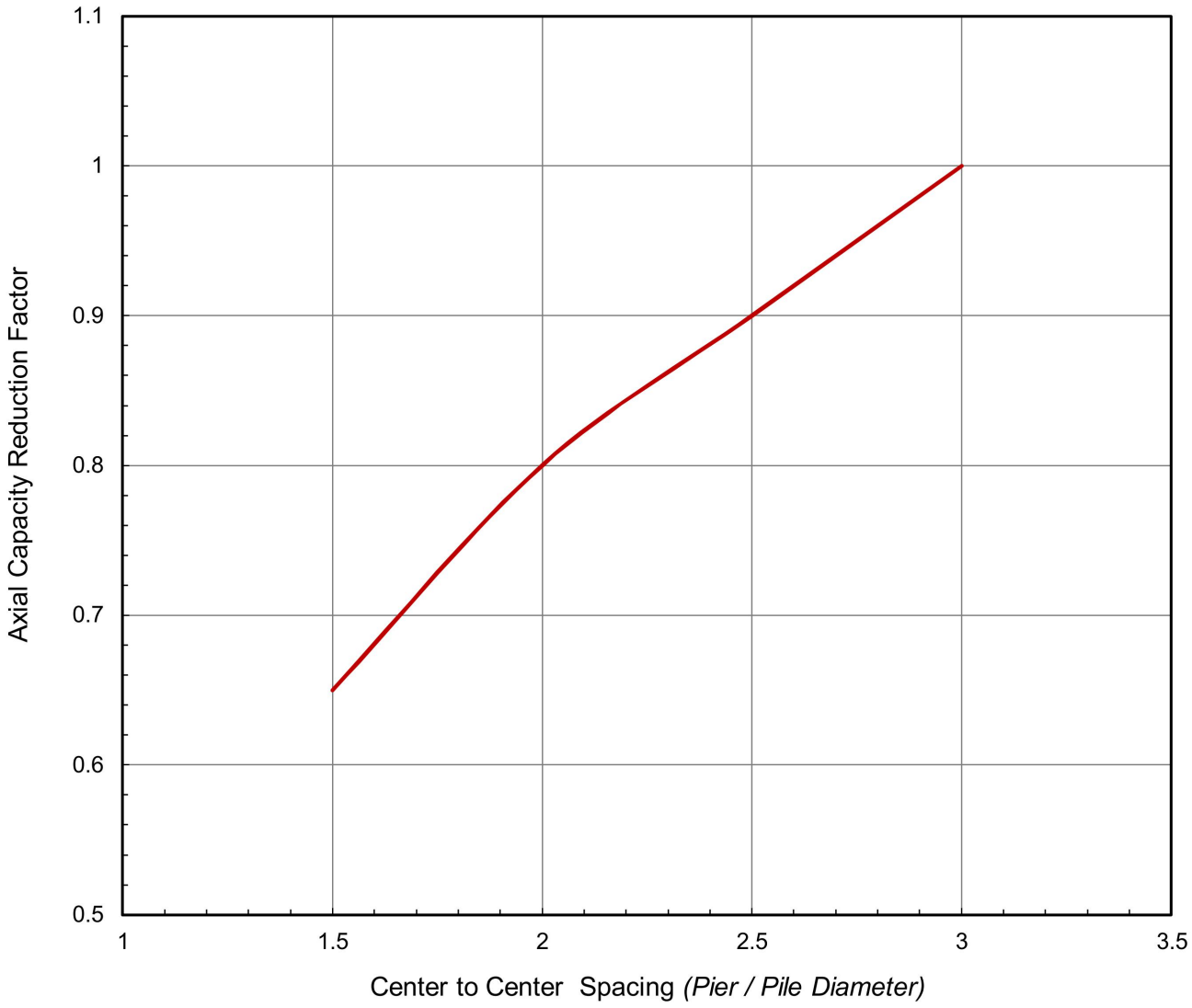
▽ Water Level at Time of Drilling, or as Shown

▼ Water Level at End of Drilling, or as Shown

▼ Water Level After 24 Hours, or as Shown

NV	No Value
NP	Non-Plastic
1	Refusal

FIGURE: 4



Axial Capacity Reductions as Functions of Closely Spaced Pier / Pile Elements.

The graph above provides estimated reductions in total axial capacity for closely spaced piers.

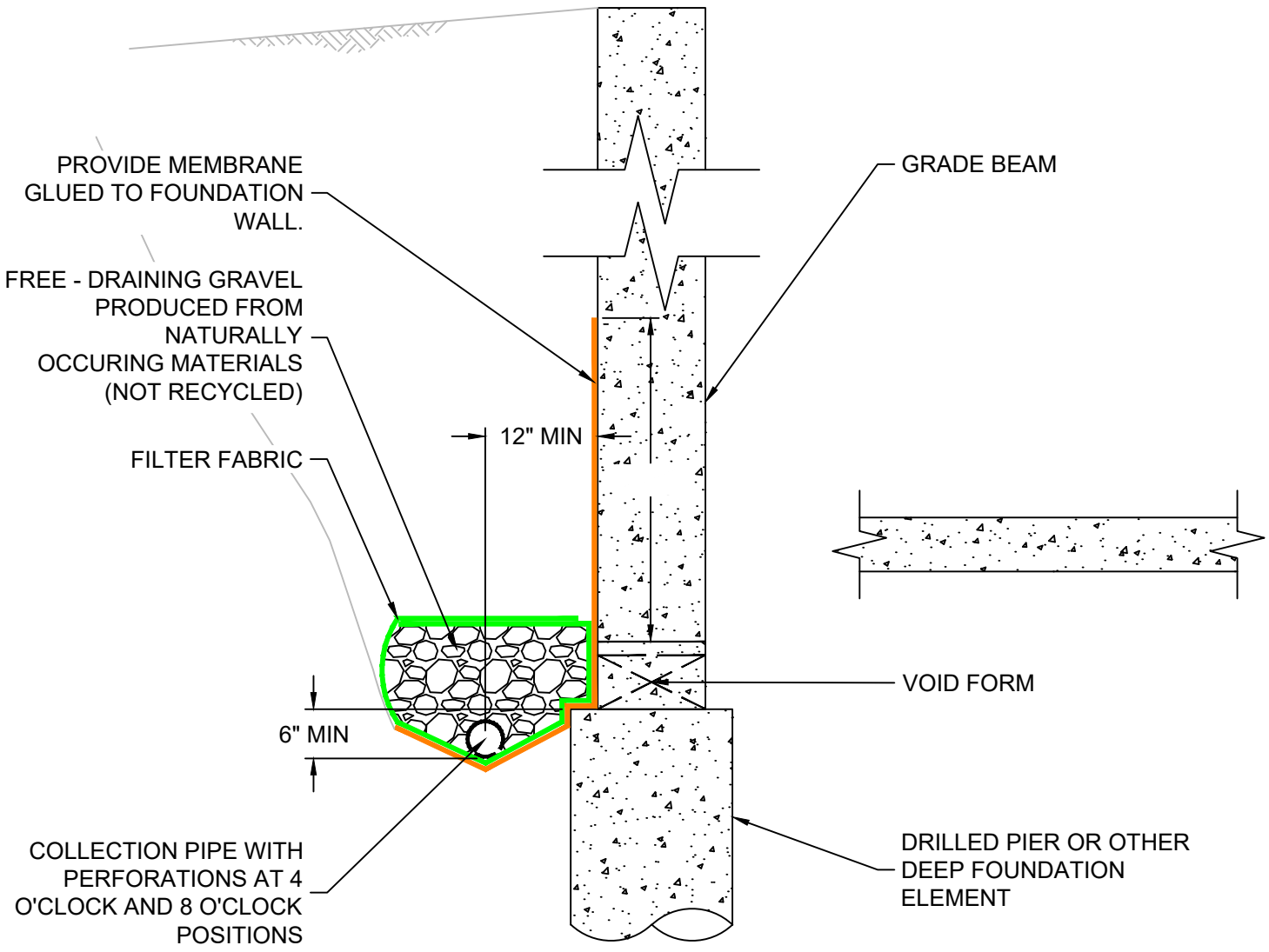
Pier / Pile reductions should be interpolated from the graph above.

GROUND ENGINEERING

JOB NO.: 22-3677A

FIGURE: 5

AXIAL CAPACITY
REDUCTION FACTORS
FOR CLOSELY SPACED PIERS / PILES



NOTES:

1. This is NOT a design - level drawing. it should be used solely for general information purposes only. Actual Underdrain design should be completed by others.
2. The underdrain system must be tested by the contractor after installation and backfilling to verify that it functions properly.
3. Inclusion of this figure in construction documents is done so at the document preparer's risk.
4. Reproduction of this document should be in color.

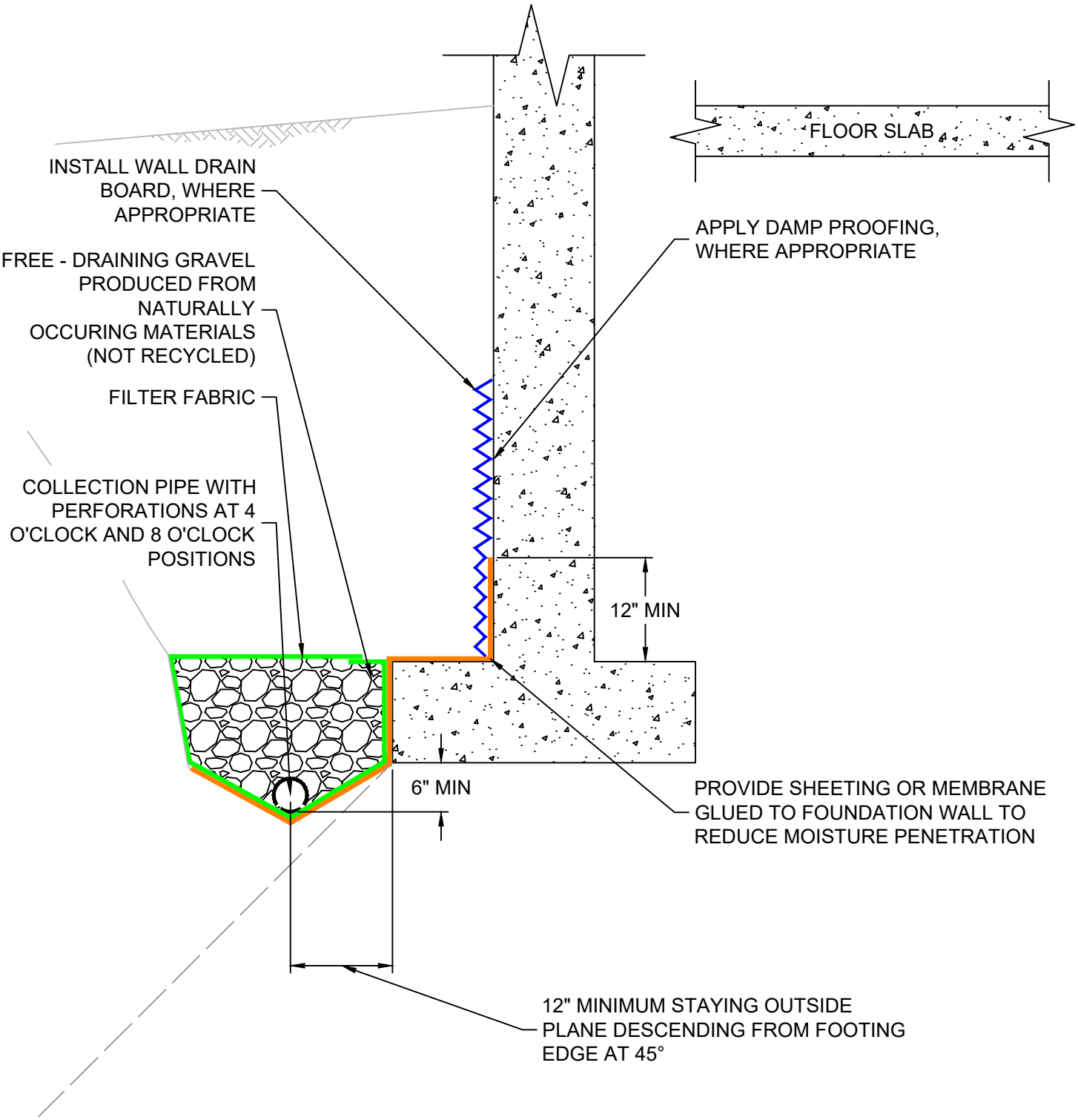
NOT TO SCALE
SEE TEXT FOR ADDITIONAL INFORMATION

GROUND ENGINEERING

JOB NO.: 22-3677A

FIGURE: 6

TYPICAL UNDERDRAIN DETAIL



NOTES:

1. This is NOT a design - level drawing. it should be used solely for general information purposes only. Actual Underdrain design should be completed by others.
2. The underdrain system must be tested by the contractor after installation and backfilling to verify that it functions properly.
3. Inclusion of this figure in construction documents is done so at the document preparer's risk.
4. Reproduction of this document should be in color.

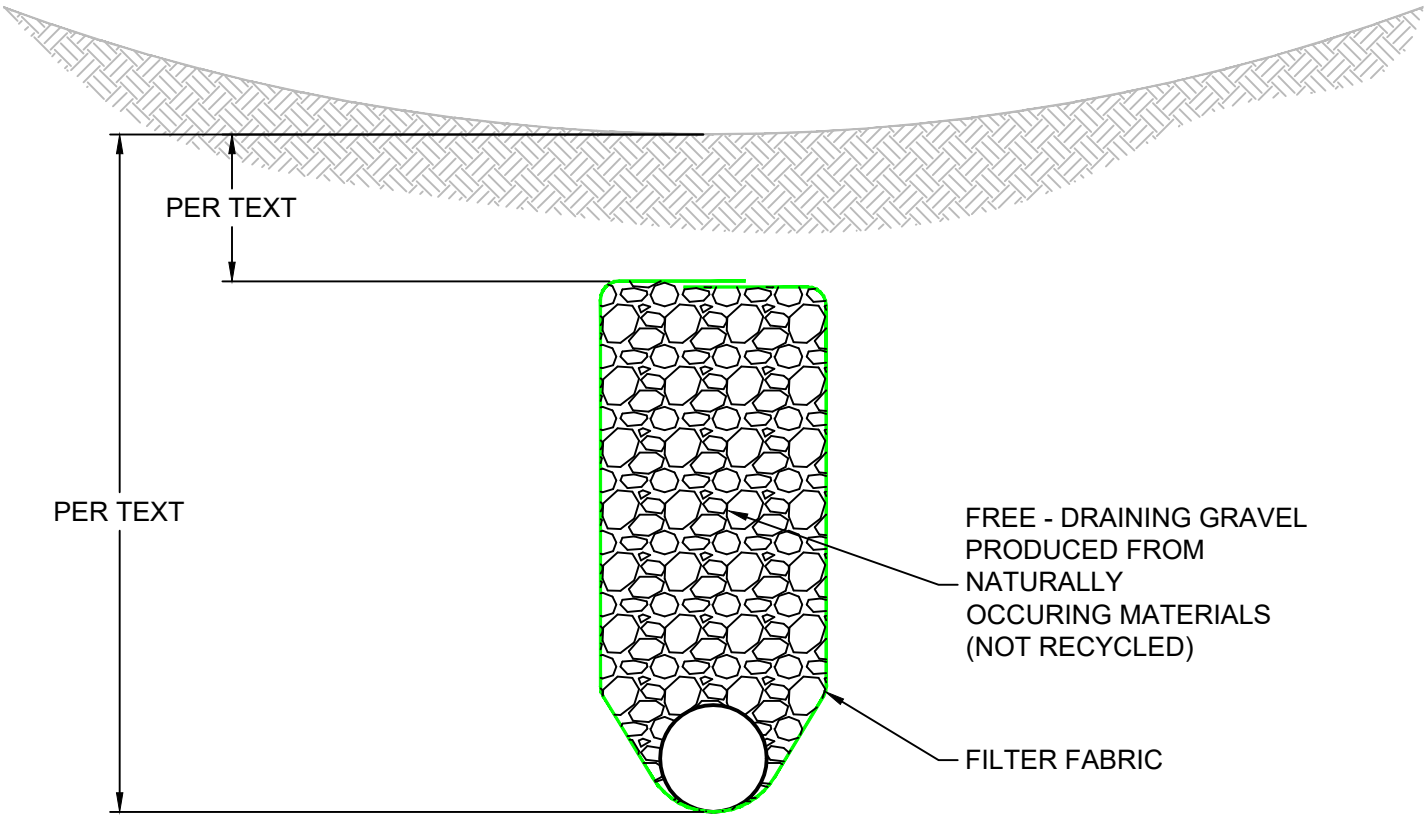
NOT TO SCALE
SEE TEXT FOR ADDITIONAL INFORMATION

GROUND ENGINEERING

JOB NO.: 22-3677A

FIGURE: 7

TYPICAL UNDERDRAIN DETAIL



NOTES:

1. This is NOT a design - level drawing. it should be used solely for general information purposes only. Actual Underdrain design should be completed by others.
2. The underdrain system must be tested by the contractor after installation and backfilling to verify that it functions properly.
3. Inclusion of this figure in construction documents is done so at the document preparer's risk.
4. Reproduction of this document should be in color.

NOT TO SCALE
SEE TEXT FOR ADDITIONAL INFORMATION

GROUND ENGINEERING

JOB NO.: 22-3677A

FIGURE: 8

INTERCEPTOR DRAIN DETAIL

GROUND ENGINEERING

Bergen Valley Elementary School - Additions and Facility Improvements

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural	Natural	Gradation			Atterberg Limits		Swell/Consolidation		Unconfined Compressive Strength		USCS	AASHTO	Sample Description
Test Hole No.	Depth (feet)	Moisture Content (%)	Dry Density (pcf)	Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index	Volume Change (%)	Surcharge Pressure (psf)	(psi)	(ksf)	Equivalent Classification	Equivalent Classification (Group Index)	
1	6	9.4	108.4	0	71	28.6	20	4	-0.3	750	-	-	SM	A-2-4 (0)	FILL: Silty SAND
1	11	8.4	124.2	2	59	38.7	22	5	-	-	-	-	SC-SM	A-4 (0)	Silty, Clayey SAND
1	16	6.1	109.4	-	-	-	-	-	-	-	-	-	-	-	SAND with Silt
1	36	9.4	120.0	2	51	46.8	21	5	-	-	28.8	4.15	SC-SM	A-4 (0)	GNEISS Bedrock
2	4	7.2	130.1	12	61	27.4	24	5	0	500	-	-	SC-SM	A-2-4 (0)	FILL: Silty, Clayey SAND
2	14	9.3	120.8	23	51	26.1	26	7	-	-	-	-	(SC)g	A-2-4 (0)	Clayey SAND with Gravel
3	2	7.4	122.7	18	65	16.9	23	5	-	-	-	-	(SC-SM)g	A-2-4 (0)	FILL: Silty, Clayey SAND with Gravel
3	7	6.9	117.8	29	56	14.6	24	5	-	-	-	-	(SC-SM)g	A-1-b (0)	FILL: Silty, Clayey SAND with Gravel
3	22	15.4	105.8	0	61	39.1	27	7	-	-	-	-	SC	A-4 (0)	Clayey SAND
3	39	8.5	111.9	0	82	18.1	*NV*	*NP*	-	-	-	-	SM	A-2-4 (0)	GNEISS Bedrock
PP-1	1	7.0	*SD*	10	67	22.9	23	2	-	-	-	-	SM	A-2-4 (0)	FILL: Silty SAND
PP-2	4	10.6	106.6	3	61	35.6	24	5	-	-	-	-	SC-SM	A-4 (0)	Silty, Clayey SAND
PP-2	9	10.2	119.6	1	71	28.2	23	5	-	-	-	-	SC-SM	A-2-4 (0)	Silty, Clayey SAND
PP-3	3	1.9	*SD*	12	67	20.7	20	5	-	-	-	-	SC-SM	A-2-4 (0)	GNEISS Bedrock
PP-3	13	3.4	*SD*	1	45	53.9	*NV*	*NP*	-	-	-	-	s(ML)	A-4 (0)	GNEISS Bedrock
RW-1	2	4.8	*SD*	39	42	19.2	25	7	-	-	-	-	(SC-SM)g	A-2-4 (0)	Silty, Clayey SAND with Gravel
RW-1	7	3.8	*SD*	12	68	20.0	22	5	-	-	-	-	SC-SM	A-2-4 (0)	Silty, Clayey SAND
RW-1	12	3.4	*SD*	29	46	25.5	20	4	-	-	-	-	(SC-SM)g	A-2-4 (0)	Silty, Clayey SAND with Gravel
RW-1, PP-1 - PP-3	0 - 10	5.9	*SD*	16	62	21.6	26	6	-	-	-	-	(SC-SM)g	A-1-b (0)	Silty, Clayey SAND with Gravel

SD = Sample disturbed, NV = No value, NP = Non-plastic

Job No. 22-3677A

TABLE 2: SUMMARY OF SOIL CORROSION TEST RESULTS

Sample Location		Water Soluble Sulfates	pH	Redox Potential	Sulfide Reactivity	Resistivity	USCS Equivalent Classification	AASHTO Equivalent Classification (Group Index)	Sample Description
Test Hole No.	Depth (feet)	(%)		(mv)		(ohm-cm)			
2	4	0.01	8.2	- 63	Trace	5,445	SC-SM	A-2-4 (0)	FILL: Silty, Clayey SAND
PP-2	4	0.06	7.6	- 22	Trace	9,643	SC-SM	A-4 (0)	Silty, Clayey SAND

Job No. 22-3677A

Appendix A

Detailed Logs of the Test Holes

GROUND ENGINEERING

TEST HOLE 1

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7711	0		**TOPSOIL:** Approximately 2 inches of topsoil.										
			FILL: Silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.		32-17-16								
7706	5				8/12	9.4	108.4	0	71	29	20	4	SM
7701	10		**SILTY to CLAYEY SANDS with GRAVEL:** Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.		17/12	8.4	124.2	2	59	39	22	5	SC-SM
7696	15				20/12	6.1	109.4						
7691	20				19/12								
7686	25				22/12								
7681	30				50/7								
7676 ▽	35		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly. Groundwater encountered at 35 feet at time of drilling.		50/2	9.4	120	2	51	47	21	5	SC-SM

Bottom of borehole at Approx. 36.17 feet.

GROUND ENGINEERING

TEST HOLE 2

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7710	0		**TOPSOIL:** Approximately 2 inches of topsoil.										
			FILL: Silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.										
7705	5				33/12	7.2	130.1	12	61	27	24	5	SC-SM
			SILTY to CLAYEY SANDS with GRAVEL: Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.										
7700	10				27/12								
7695	15				21/12	9.3	120.8	23	51	26	26	7	(SC)g
7690	20				33/12								
7685	25		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.		50/6								
					50/5								

Bottom of borehole at Approx. 29.5 feet.

GROUND ENGINEERING

TEST HOLE 3

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7708	0		**CONCRETE:** Approximately 4 inches of concrete.										
			FILL: Silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.		37/12	7.4	122.7	18	65	17	23	5	(SC-SM)g
7703	5												
					24/12	6.9	117.8	29	56	15	24	5	(SC-SM)g
7698	10												
					33/12								
7693	15												
					50/10								
7688	20												
			SILTY to CLAYEY SANDS with GRAVEL: Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.		21/12	15.4	105.8	0	61	39	27	7	SC
7683	25												
					29/12								
7678	30												
					28/12								
7673	35												
			GNEISS BEDROCK: Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.		50/8	8.5	111.9	0	82	18	NV	NP	SM

Bottom of borehole at Approx. 39.67 feet.

GROUND ENGINEERING

TEST HOLE RW-1

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7710.0	0.0		**ASPHALT:** Approximately 5 inches of asphalt.										
			FILL: Silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.										
7707.5	2.5		**SILTY to CLAYEY SANDS with GRAVEL:** Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.		12-16-7	4.8	SD	39	42	19	25	7	(SC-SM)g
7705.0	5.0												
7702.5	7.5				3-6-21	3.8	SD	12	68	20	22	5	SC-SM
7700.0	10.0												
7697.5	12.5				30/12	3.4	SD	29	46	26	20	4	(SC-SM)g
7695.0	15.0		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.		50/4								

Bottom of borehole at Approx. 17.33 feet.

GROUND ENGINEERING

TEST HOLE PP-1

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7704.0	0.0		**ROAD BASE:** Approximately 4 inches of road base.										
7701.5	2.5		**FILL:** Silty to clayey sands with gravels. The coarse fractions included fine to coarse sands, gravels, scattered cobbles and boulders. They were slightly plastic, slightly moist to moist, and brown to gray-brown to dark brown in color. Iron staining was noted commonly.		30-15-11	7	SD	10	67	23	23	2	SM
			GNEISS BEDROCK: Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.		50/4								

Bottom of borehole at Approx. 4.33 feet.

GROUND ENGINEERING

TEST HOLE PP-2

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation Gravel %	Gradation Sand %	Gradation Fines %	Atterberg Limits Liquid Limit	Atterberg Limits Plasticity Index	USCS
7704.0	0.0		**TOPSOIL:** Approximately 3 inches of topsoil.										
7701.5	2.5		**SILTY to CLAYEY SANDS with GRAVEL:** Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.										
7699.0	5.0				9/12	10.6	106.6	3	61	36	24	5	SC-SM
7696.5	7.5												
7694.0	10.0				17/12	10.2	119.6	1	71	28	23	5	SC-SM
7691.5	12.5		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.		50/7								
7689.0	15.0												
7686.5	17.5				50/3								

Bottom of borehole at Approx. 19.25 feet.

GROUND ENGINEERING

TEST HOLE PP-3

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
7707.0	0.0		**TOPSOIL:** Approximately 3 inches of topsoil.										
7704.5	2.5		**SILTY to CLAYEY SANDS with GRAVEL:** Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.		42-50/3	1.9	SD	12	67	21	20	5	SC-SM
7702.0	5.0		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.										
7699.5	7.5		Auger drilling refusal at approximately 6 feet, test hole offset 5 feet and advanced to depth shown on logs		50/2								
7697.0	10.0												
7694.5	12.5				50/4	3.4	SD	1	45	54	NV	NP	s(ML)

Bottom of borehole at Approx. 13.33 feet.

GROUND ENGINEERING

TEST HOLE PP-4

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Additions and Site Improvements

JOB NO: 22-3677A

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation: Gravel %	Gradation: Sand %	Gradation: Fines %	Atterberg Limits: Liquid Limit	Atterberg Limits: Plasticity Index	USCS
7723.0	0.0		**TOPSOIL:** Approximately 3 inches of topsoil.										
7720.5	2.5		**SILTY to CLAYEY SANDS with GRAVEL:** Silty to clayey sands with gravel, silty to clayey sands, and sands with silts and clays. The coarse fractions included fine to coarse sands with gravels, scattered cobbles and boulders. They were slightly plastic, loose to dense, dry to slightly moist, and light brown to dark brown to gray-brown to gray in color. Iron staining was noted locally.										
7718.0	5.0				50/5								
7715.5	7.5		**GNEISS BEDROCK:** Fine to coarse gneiss. They were foliated on various scales and generally had a 'salt and pepper' appearance and/or were heavily iron stained. They were non- to slightly plastic, very hard and relatively resistant, slightly moist, and mottled to banded light to medium brown, white, and dark gray in color. Iron staining was noted commonly.										
7713.0	10.0				50/2								
7710.5	12.5				50/2								

Refusal at 14.17 feet.
Bottom of borehole at Approx. 14.17 feet.

Appendix B

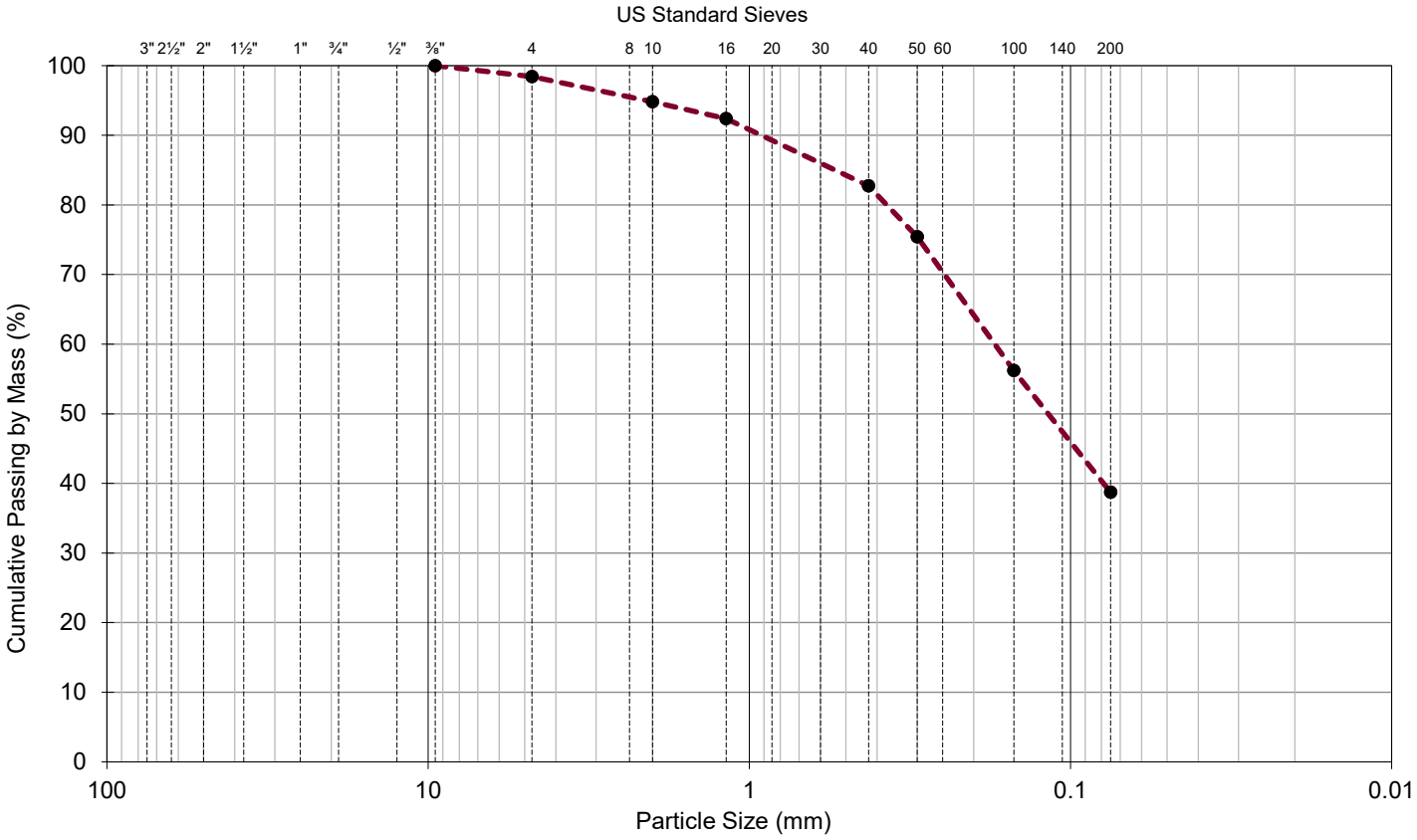
Gradation Testing Results

GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	98	D90	0.916
5 in	125	-	No. 8	2.36	-	D85	0.540
4 in	100	-	No. 10	2.00	95	D80	0.373
3 in	75	-	No. 16	1.18	92	D60	0.172
2.5 in	63	-	No. 20	0.85	-	D50	0.117
2 in	50	-	No. 30	0.60	-	D40	0.079
1.5 in	37.5	-	No. 40	0.425	83	D30	-
1 in	25.0	-	No. 50	0.300	75	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	-	No. 100	0.150	56	D05	-
3/8 in	9.5	100	No. 140	0.106	-	Cu	-
No. 4	4.75	98	No. 200	0.075	38.7	Cc	-

Location: 1 at 11 feet
Description: Silty, Clayey SAND

Classification: SC-SM / A-4 (0)
Liquid Limit: 22
Plasticity Index: 5

Gravel (%): 2
Sand (%): 59
Silt/Clay (%): 39

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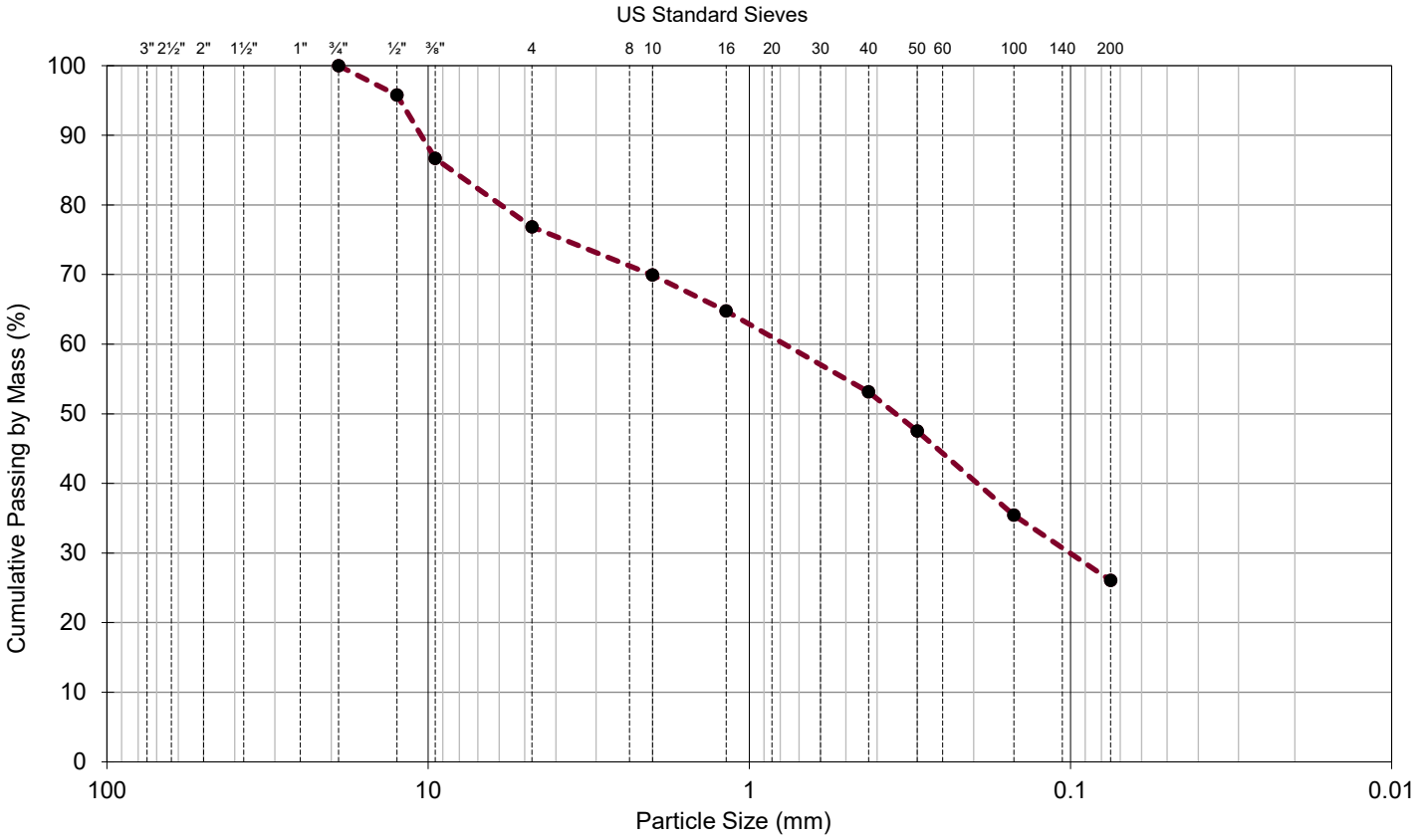
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	77	D90	10.498
5 in	125	-	No. 8	2.36	-	D85	8.436
4 in	100	-	No. 10	2.00	70	D80	5.933
3 in	75	-	No. 16	1.18	65	D60	0.777
2.5 in	63	-	No. 20	0.85	-	D50	0.350
2 in	50	-	No. 30	0.60	-	D40	0.195
1.5 in	37.5	-	No. 40	0.425	53	D30	0.100
1 in	25.0	-	No. 50	0.300	47	D15	-
3/4 in	19.0	100	No. 60	0.250	-	D10	-
1/2 in	12.5	96	No. 100	0.150	35	D05	-
3/8 in	9.5	87	No. 140	0.106	-	Cu	-
No. 4	4.75	77	No. 200	0.075	26.1	Cc	-

Location: 2 at 14 feet
Description: Clayey SAND with Gravel

Classification: (SC)g / A-2-4 (0)
Liquid Limit: 26
Plasticity Index: 7

Gravel (%): 23
Sand (%): 51
Silt/Clay (%): 26

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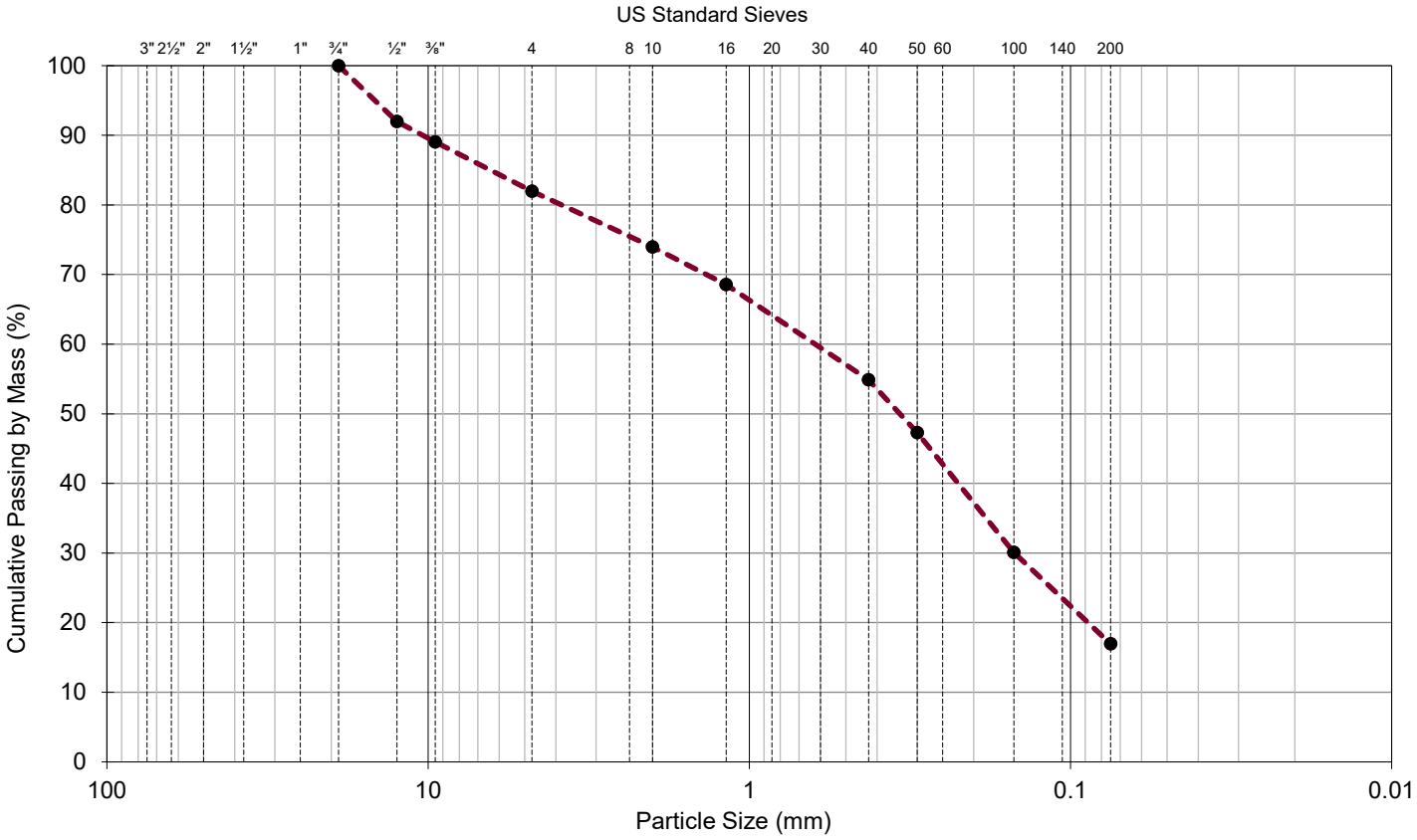
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	82	D90	10.408
5 in	125	-	No. 8	2.36	-	D85	6.409
4 in	100	-	No. 10	2.00	74	D80	3.852
3 in	75	-	No. 16	1.18	69	D60	0.623
2.5 in	63	-	No. 20	0.85	-	D50	0.340
2 in	50	-	No. 30	0.60	-	D40	0.224
1.5 in	37.5	-	No. 40	0.425	55	D30	0.149
1 in	25.0	-	No. 50	0.300	47	D15	-
3/4 in	19.0	100	No. 60	0.250	-	D10	-
1/2 in	12.5	92	No. 100	0.150	30	D05	-
3/8 in	9.5	89	No. 140	0.106	-	Cu	-
No. 4	4.75	82	No. 200	0.075	16.9	Cc	-

Location: 3 at 2 feet
Description: FILL: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-2-4 (0)
Liquid Limit: 23
Plasticity Index: 5

Gravel (%): 18
Sand (%): 65
Silt/Clay (%): 17

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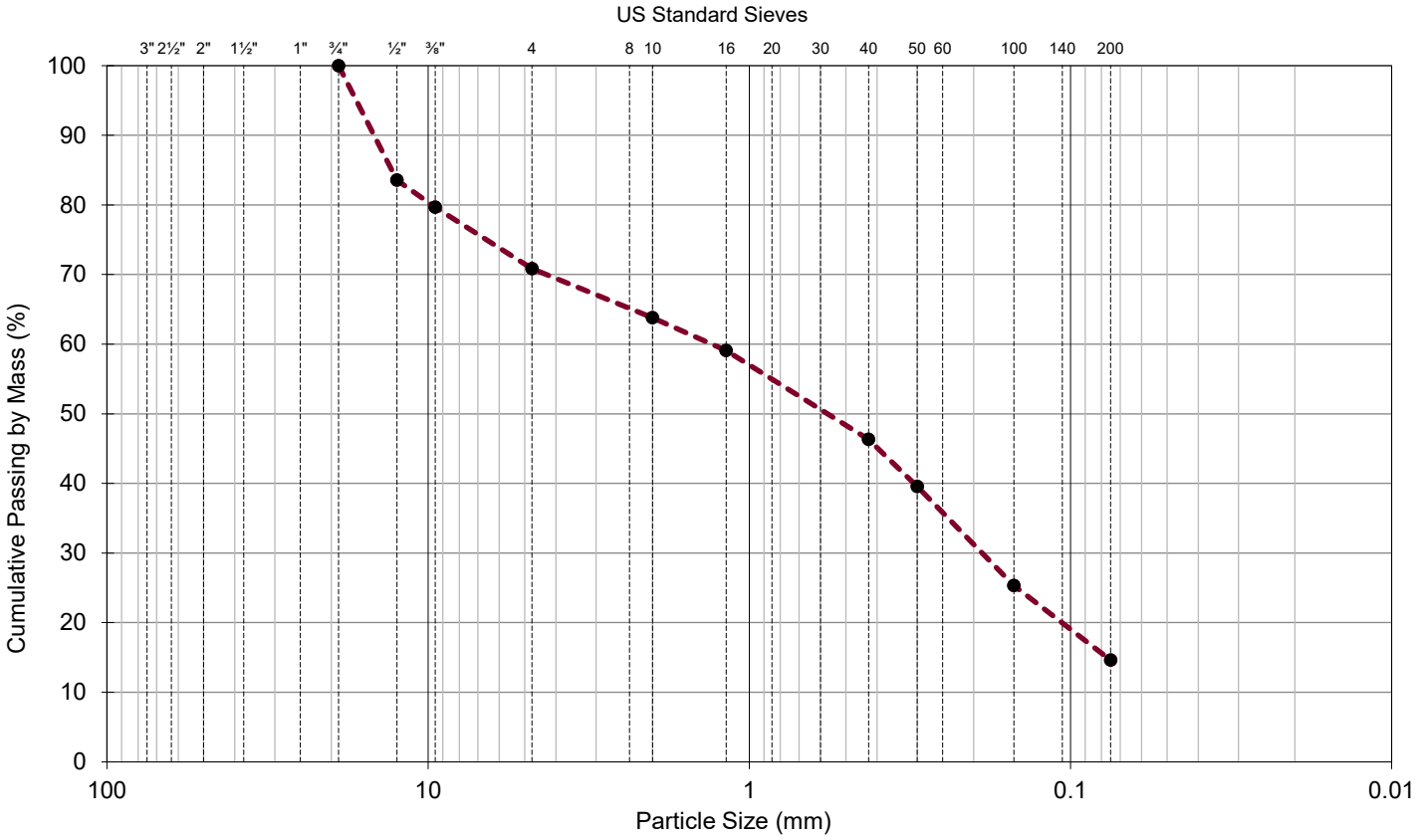
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	71	D90	14.727
5 in	125	-	No. 8	2.36	-	D85	12.965
4 in	100	-	No. 10	2.00	64	D80	9.714
3 in	75	-	No. 16	1.18	59	D60	1.310
2.5 in	63	-	No. 20	0.85	-	D50	0.570
2 in	50	-	No. 30	0.60	-	D40	0.307
1.5 in	37.5	-	No. 40	0.425	46	D30	0.188
1 in	25.0	-	No. 50	0.300	40	D15	0.077
3/4 in	19.0	100	No. 60	0.250	-	D10	-
1/2 in	12.5	84	No. 100	0.150	25	D05	-
3/8 in	9.5	80	No. 140	0.106	-	Cu	-
No. 4	4.75	71	No. 200	0.075	14.6	Cc	-

Location: 3 at 7 feet
Description: FILL: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-1-b (0)
Liquid Limit: 24
Plasticity Index: 5

Gravel (%): 29
Sand (%): 56
Silt/Clay (%): 15

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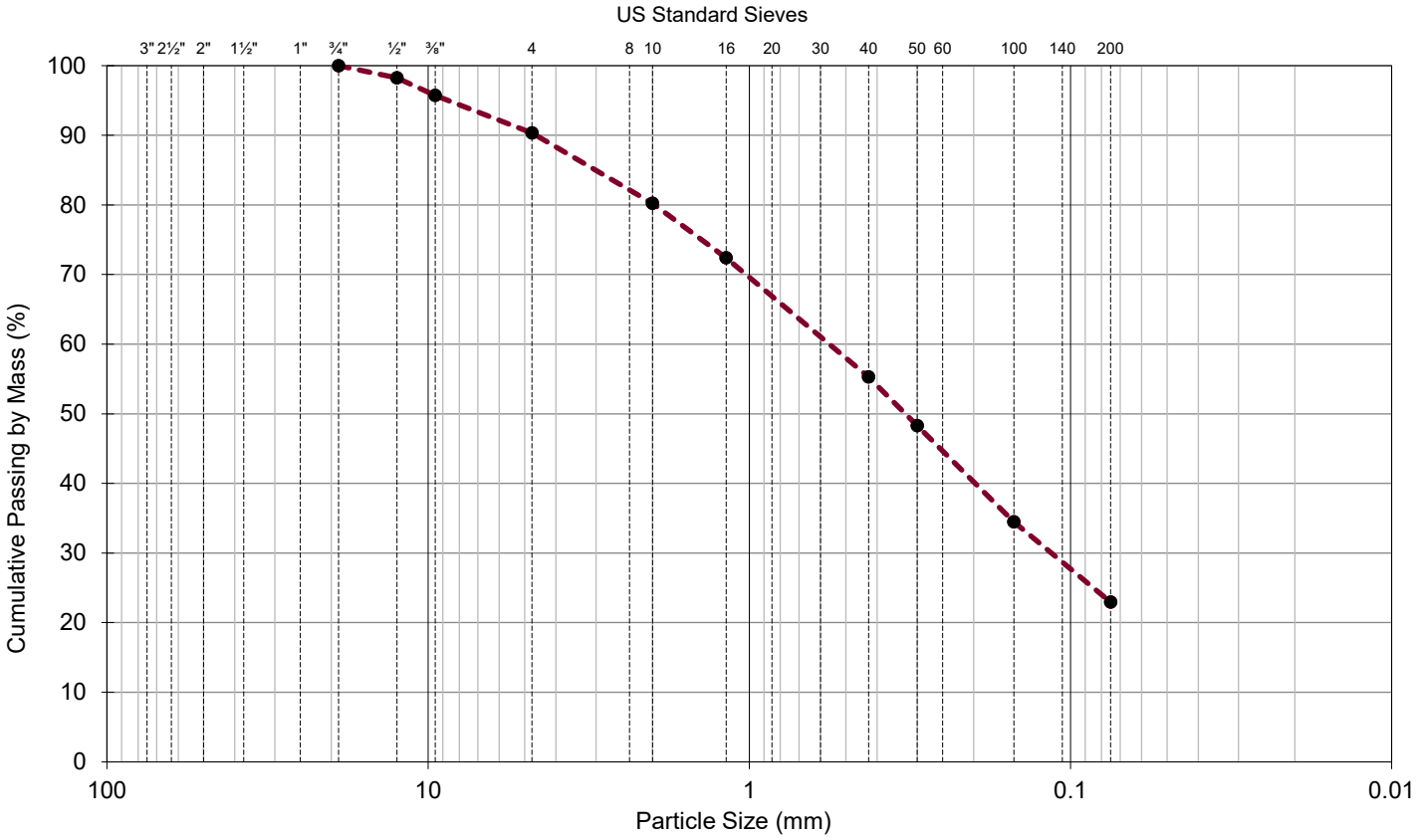
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	90	D90	4.617
5 in	125	-	No. 8	2.36	-	D85	3.013
4 in	100	-	No. 10	2.00	80	D80	1.973
3 in	75	-	No. 16	1.18	72	D60	0.563
2.5 in	63	-	No. 20	0.85	-	D50	0.327
2 in	50	-	No. 30	0.60	-	D40	0.198
1.5 in	37.5	-	No. 40	0.425	55	D30	0.115
1 in	25.0	-	No. 50	0.300	48	D15	-
3/4 in	19.0	100	No. 60	0.250	-	D10	-
1/2 in	12.5	98	No. 100	0.150	34	D05	-
3/8 in	9.5	96	No. 140	0.106	-	Cu	-
No. 4	4.75	90	No. 200	0.075	22.9	Cc	-

Location: PP-1 at 1 feet
Description: FILL: Silty SAND

Classification: SM / A-2-4 (0)
Liquid Limit: 23
Plasticity Index: 2

Gravel (%): 10
Sand (%): 67
Silt/Clay (%): 23

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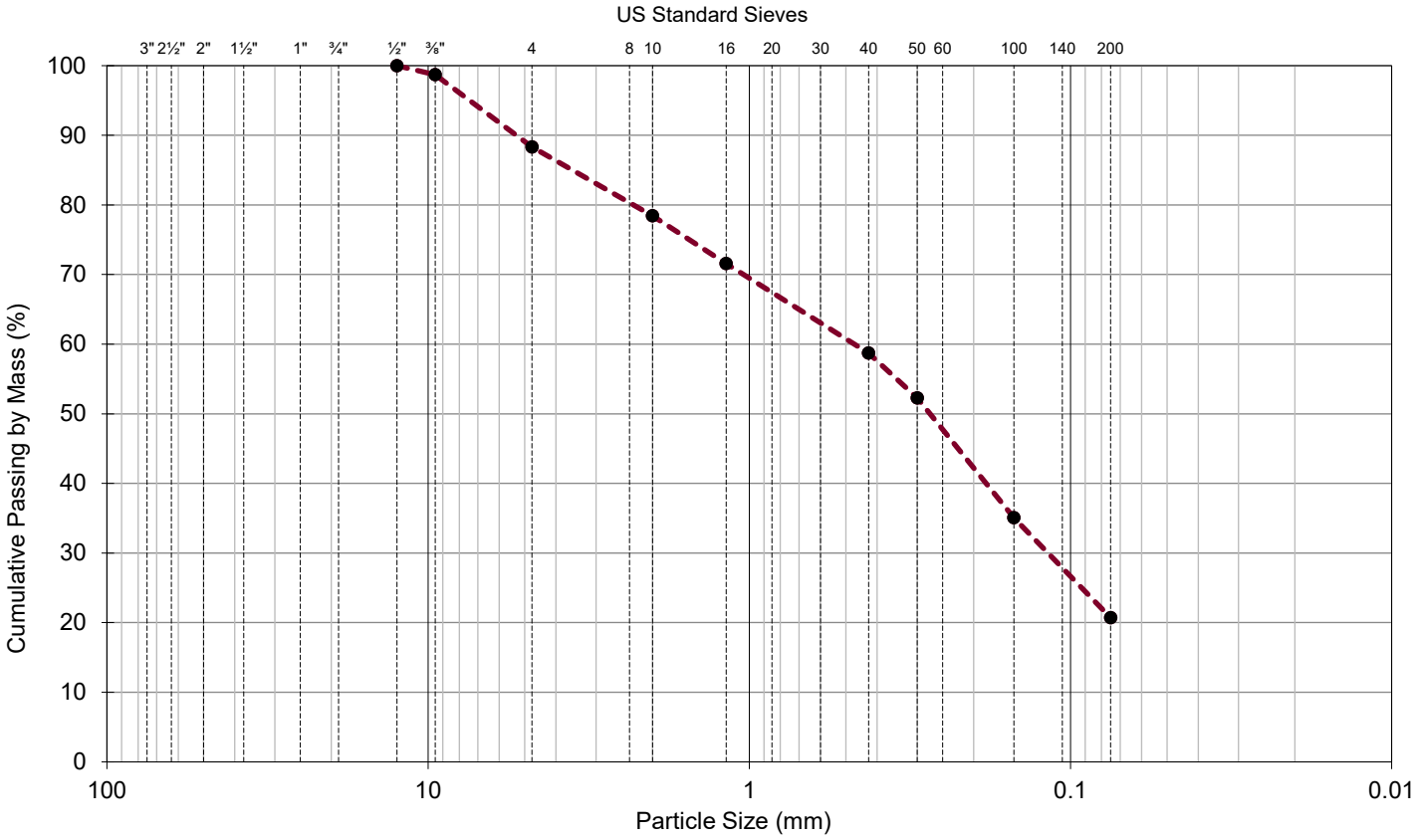
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	88	D90	5.308
5 in	125	-	No. 8	2.36	-	D85	3.550
4 in	100	-	No. 10	2.00	78	D80	2.295
3 in	75	-	No. 16	1.18	72	D60	0.470
2.5 in	63	-	No. 20	0.85	-	D50	0.274
2 in	50	-	No. 30	0.60	-	D40	0.183
1.5 in	37.5	-	No. 40	0.425	59	D30	0.117
1 in	25.0	-	No. 50	0.300	52	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	100	No. 100	0.150	35	D05	-
3/8 in	9.5	99	No. 140	0.106	-	Cu	-
No. 4	4.75	88	No. 200	0.075	20.7	Cc	-

Location: PP-3 at 3 feet
Description: GNEISS Bedrock

Classification: SC-SM / A-2-4 (0)
Liquid Limit: 20
Plasticity Index: 5

Gravel (%): 12
Sand (%): 67
Silt/Clay (%): 21

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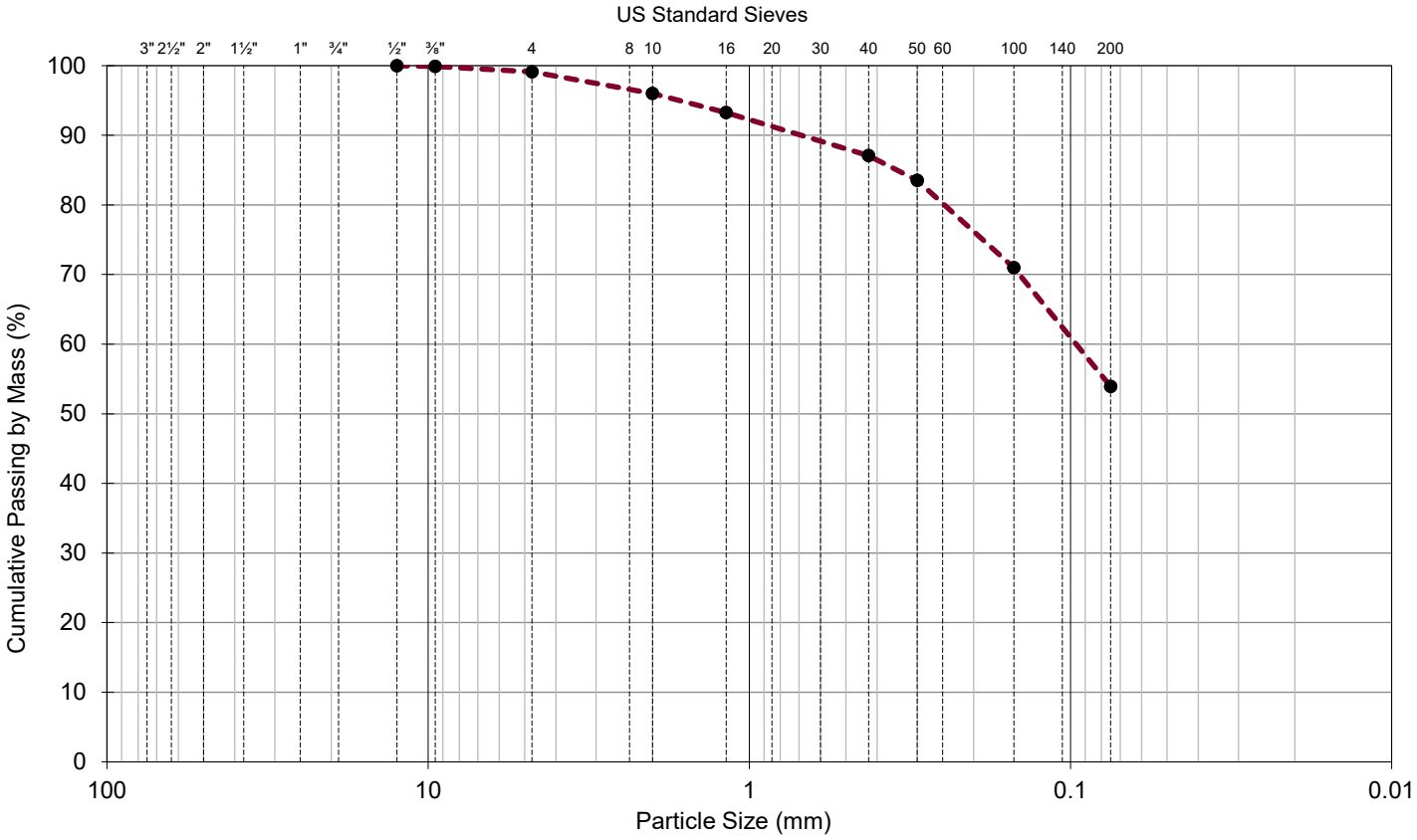
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	99	D90	0.688
5 in	125	-	No. 8	2.36	-	D85	0.347
4 in	100	-	No. 10	2.00	96	D80	0.247
3 in	75	-	No. 16	1.18	93	D60	0.096
2.5 in	63	-	No. 20	0.85	-	D50	-
2 in	50	-	No. 30	0.60	-	D40	-
1.5 in	37.5	-	No. 40	0.425	87	D30	-
1 in	25.0	-	No. 50	0.300	84	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	100	No. 100	0.150	71	D05	-
3/8 in	9.5	100	No. 140	0.106	-	Cu	-
No. 4	4.75	99	No. 200	0.075	53.9	Cc	-

Location: PP-3 at 13 feet
Description: GNEISS Bedrock

Classification: s(ML) / A-4 (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 1
Sand (%): 45
Silt/Clay (%): 54

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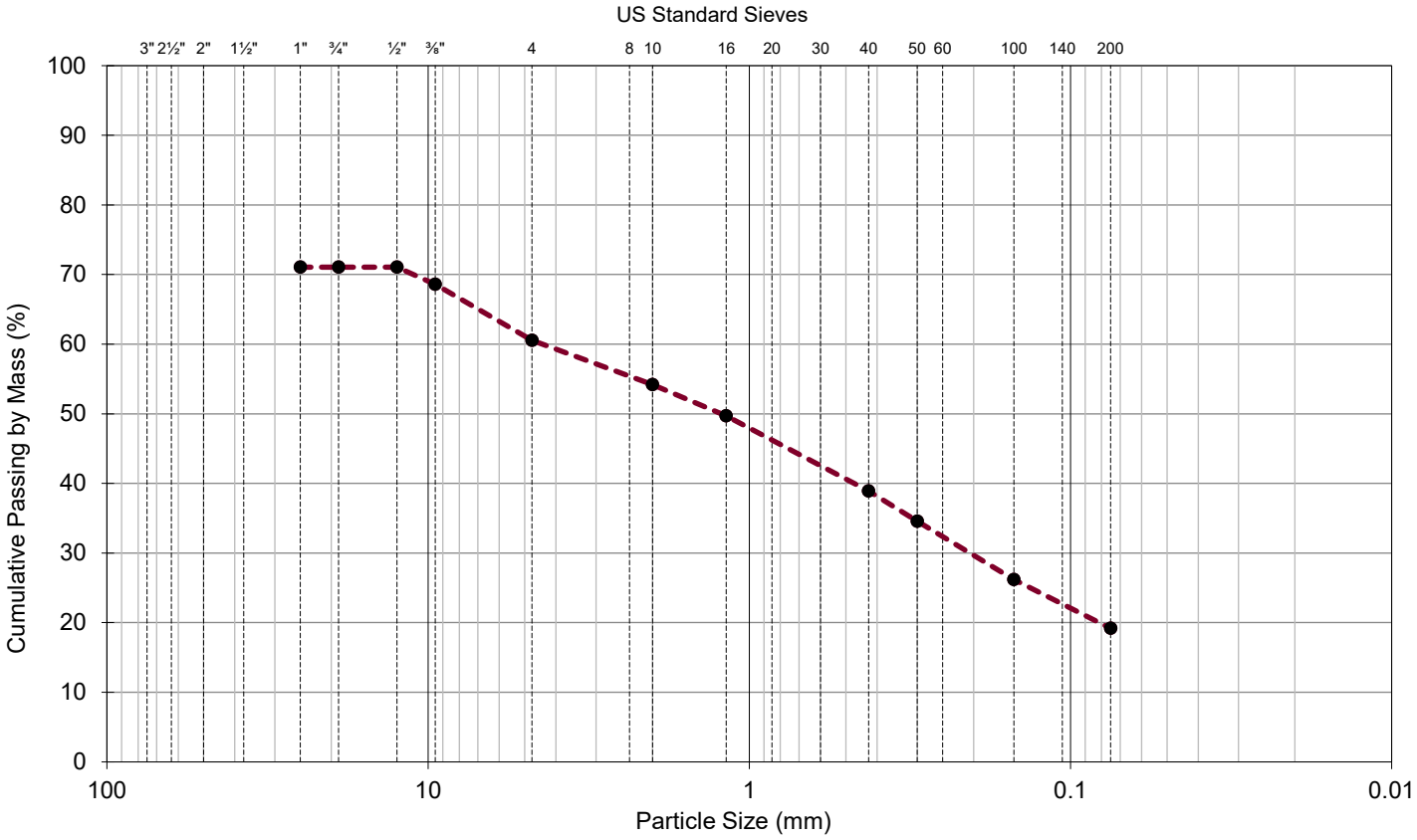
GROUND ENGINEERING

Project No.: 22-3677A

Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	61	D90	#N/A
5 in	125	-	No. 8	2.36	-	D85	#N/A
4 in	100	-	No. 10	2.00	54	D80	#N/A
3 in	75	-	No. 16	1.18	50	D60	4.419
2.5 in	63	-	No. 20	0.85	-	D50	1.219
2 in	50	-	No. 30	0.60	-	D40	0.471
1.5 in	37.5	-	No. 40	0.425	39	D30	0.206
1 in	25.0	71	No. 50	0.300	35	D15	-
3/4 in	19.0	71	No. 60	0.250	-	D10	-
1/2 in	12.5	71	No. 100	0.150	26	D05	-
3/8 in	9.5	69	No. 140	0.106	-	Cu	-
No. 4	4.75	61	No. 200	0.075	19.2	Cc	-

Location: RW-1 at 2 feet
Description: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-2-4 (0)
Liquid Limit: 25
Plasticity Index: 7

Gravel (%): 39
Sand (%): 42
Silt/Clay (%): 19

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GROUND ENGINEERING

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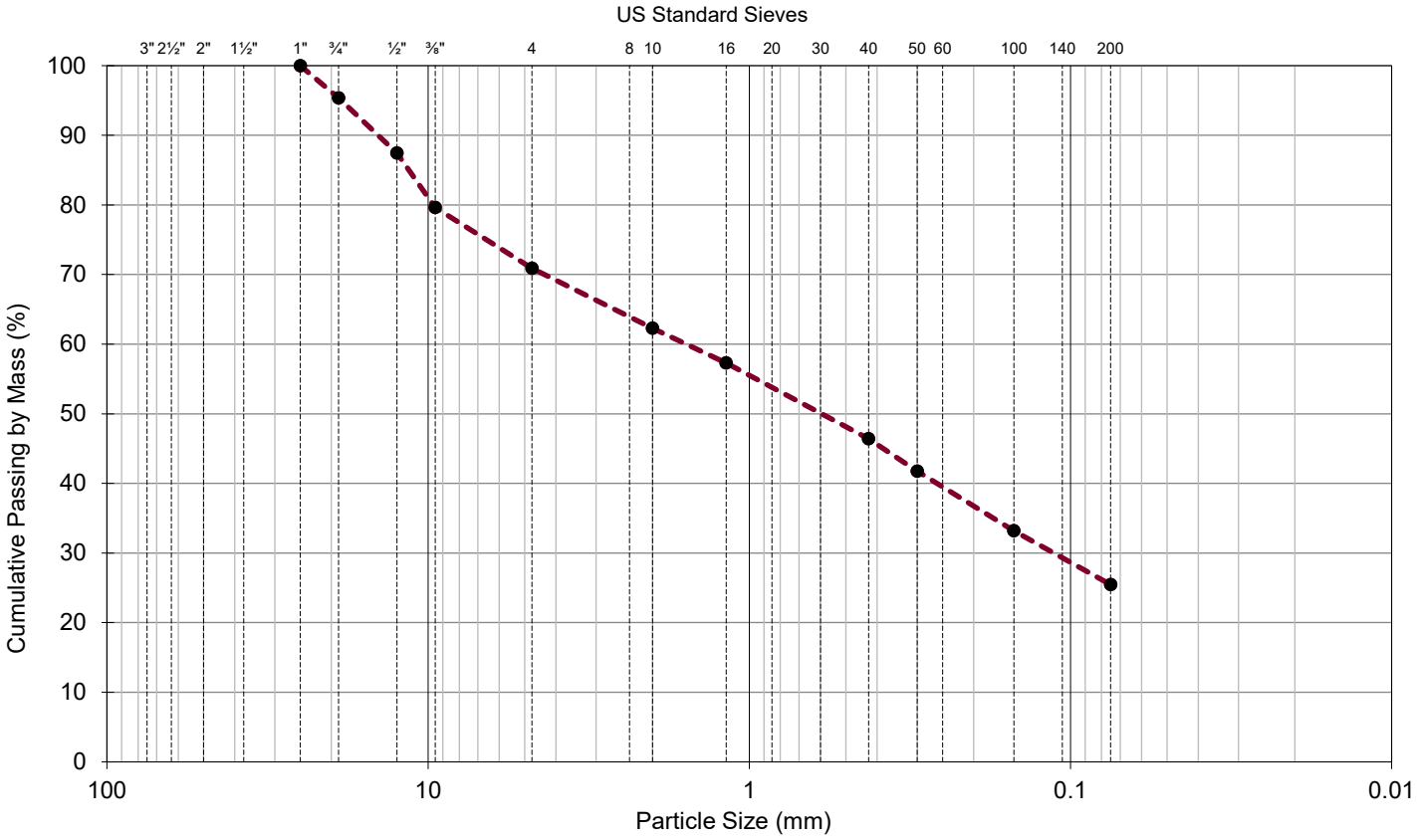
Bergen Valley Elementary School
Additions and Facility Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	71	D90	14.295
5 in	125	-	No. 8	2.36	-	D85	11.465
4 in	100	-	No. 10	2.00	62	D80	9.623
3 in	75	-	No. 16	1.18	57	D60	1.570
2.5 in	63	-	No. 20	0.85	-	D50	0.595
2 in	50	-	No. 30	0.60	-	D40	0.260
1.5 in	37.5	-	No. 40	0.425	46	D30	0.113
1 in	25.0	100	No. 50	0.300	42	D15	-
3/4 in	19.0	95	No. 60	0.250	-	D10	-
1/2 in	12.5	87	No. 100	0.150	33	D05	-
3/8 in	9.5	80	No. 140	0.106	-	Cu	-
No. 4	4.75	71	No. 200	0.075	25.5	Cc	-

Location: RW-1 at 12 feet
Description: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-2-4 (0)
Liquid Limit: 20
Plasticity Index: 4

Gravel (%): 29
Sand (%): 46
Silt/Clay (%): 25

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GROUND ENGINEERING

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Bergen Valley Elementary School
Additions and Facility Improvements

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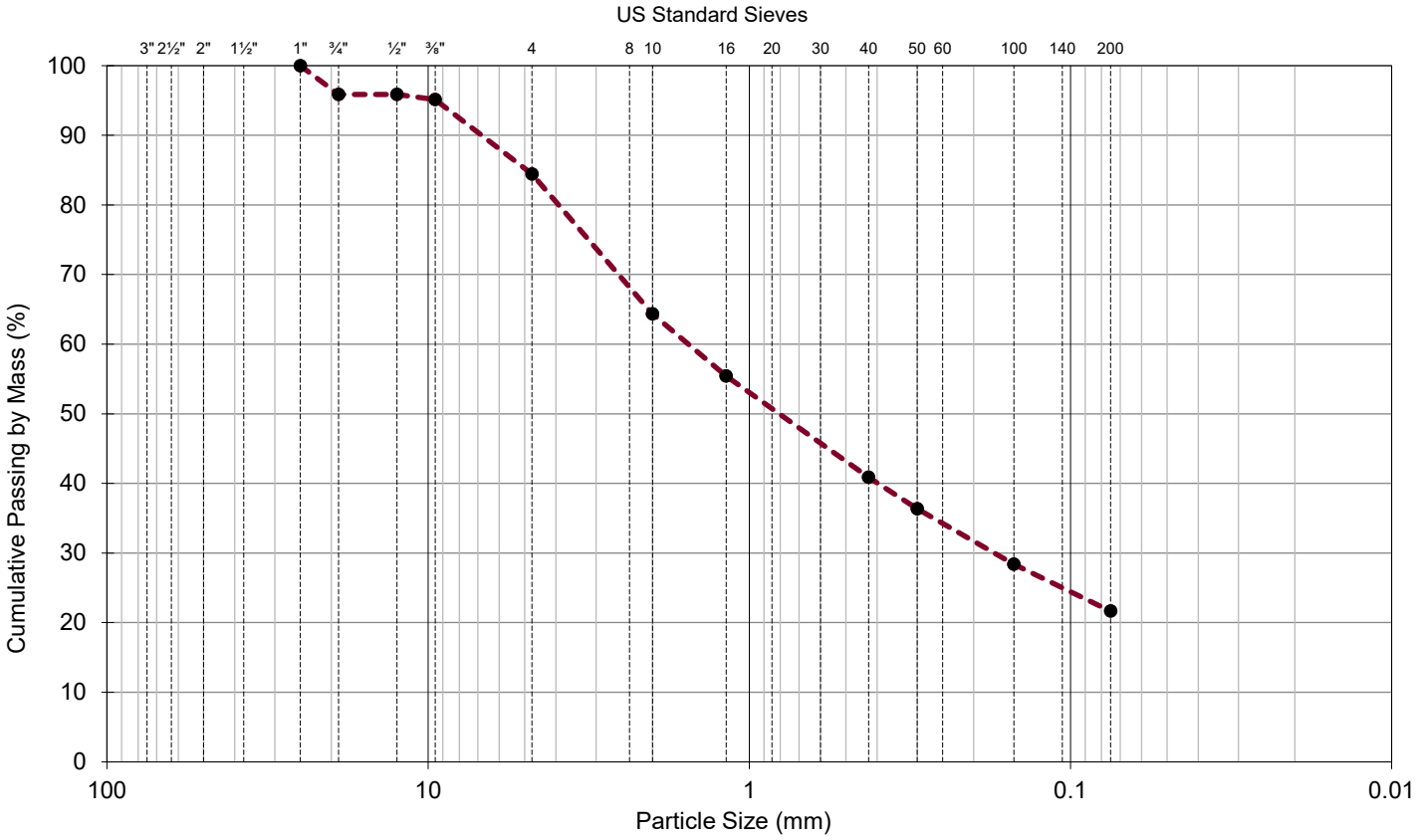

Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	84	D90	6.822
5 in	125	-	No. 8	2.36	-	D85	4.934
4 in	100	-	No. 10	2.00	64	D80	3.926
3 in	75	-	No. 16	1.18	55	D60	1.546
2.5 in	63	-	No. 20	0.85	-	D50	0.807
2 in	50	-	No. 30	0.60	-	D40	0.398
1.5 in	37.5	-	No. 40	0.425	41	D30	0.172
1 in	25.0	100	No. 50	0.300	36	D15	-
3/4 in	19.0	96	No. 60	0.250	-	D10	-
1/2 in	12.5	96	No. 100	0.150	28	D05	-
3/8 in	9.5	95	No. 140	0.106	-	Cu	-
No. 4	4.75	84	No. 200	0.075	21.6	Cc	-

Location: RW-1, PP-1 - PP-3 at 0 - 10 feet
Description: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-1-b (0)
Liquid Limit: 26
Plasticity Index: 6

Gravel (%): 16
Sand (%): 62
Silt/Clay (%): 22

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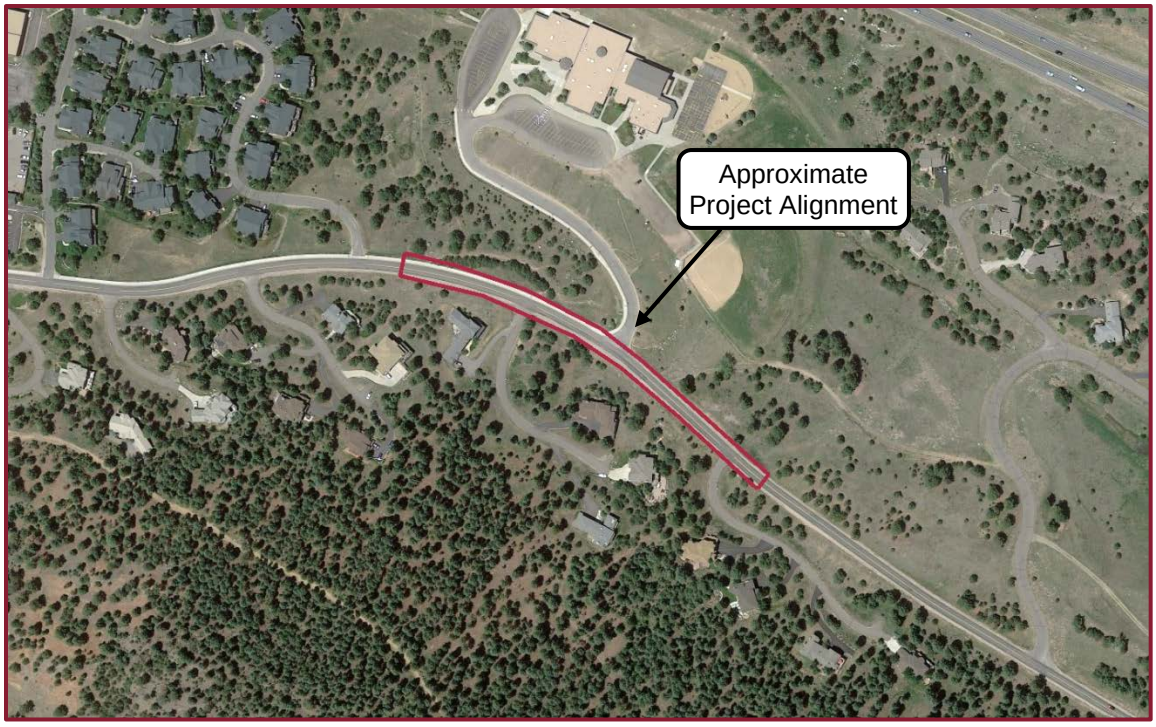
GROUND ENGINEERING

Geotechnical Evaluation and Pavement Sections
Bergen Valley Elementary School
Sugarbush Drive Improvements
Evergreen, Colorado



Prepared For:

Jeffco Public Schools
809 Quail Street, Building #4
Lakewood, Colorado 80215

Attention: Mr. Ted Hagan

Job Number: 22-3677B **March 28, 2023**

41 Inverness Drive East | Englewood, CO 80112 | (303) 289-1989 | www.groundeng.com
ENGLEWOOD | COMMERCE CITY | LOVELAND | GRANBY | GYPSUM | COLORADO SPRINGS

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PURPOSE AND SCOPE OF STUDY

This report presents the results of a geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) for Jeffco Public Schools in support of design of the proposed facility access improvements to the Bergen Valley Elementary School facility located at 1422 Sugarbush Drive in Evergreen, Colorado, more specifically, the improvements to Sugarbush Drive. Our study was conducted in general accordance with GROUND's Proposal No. 2212-2259, dated December 14, 2022, and the associated agreement and purchase order.

A field exploration program was conducted to obtain information on the subsurface conditions. Material samples obtained during the subsurface exploration were tested in the laboratory to provide data on the engineering characteristics of the site soils. The results of the field exploration and laboratory testing are presented herein.

This report has been prepared to summarize the data obtained and to present our findings and conclusions based on the proposed improvements and the subsurface conditions encountered. Design parameters and a discussion of engineering considerations related to the proposed improvements are included herein. This report should be understood and utilized in its entirety; specific sections of the text, drawings, graphs, tables, and other information contained within this report are intended to be understood in the context of the entire report. This includes the *Closure* section of the report which outlines important limitations on the information contained herein.

This report was prepared for design purposes of Jeffco Public Schools based on our understanding of the proposed project at the time of preparation of this report based on provided construction documents. The data, conclusions, opinions, and geotechnical parameters provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore, the information provided in this report was based on the exploration and testing methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases those deviations may be significant.

PROPOSED CONSTRUCTION

The following project documents and information were provided to GROUND by the Client and Project Team for development of the parameters and considerations in this report:

- **Design Development Submittal Plans -** *F04600U21_BergenValleyES Addition_DD-Dwgs_02-17-2023.pdf.* Jefferson County School District, R-1, Bergen Elementary School Addition and Renovation, Design Development Submittal. Dated February 17, 2023.
- **Traffic Impact Analysis –** *Draft Traffic Study-Bergen Valley Addn.pdf.* Bergen Valley Elementary Expansion, Jefferson County, CO, LSC #220970. Dated November 11, 2021.

Based on provided plans, we understand the Sugarbush Drive will be widened to the north so that eastbound left-turn lanes can be added to the roadway near the existing and proposed driveways for Bergen Valley Elementary School. Plans also indicate the widened roadway will be asphalt paved. Concrete sidewalks are planned north of Sugarbush Drive; retaining walls are planned north of the sidewalks. The retaining walls are planned between the existing and proposed facility driveway and to the west of the existing facility driveway.

Plans depicting the proposed grading were unavailable at the time of this report preparation. Based on the existing grades and available plans depicting the roadway extents, we assume earthen fills ranging up to approximately 3 feet will be necessary to achieve project grades. Greater thicknesses of fill are assumed to be necessary to facilitate construction of sidewalks. Based on the provided Traffic Impact Analysis report, we understand Sugarbush Drive is classified as a local roadway and is associated with a posted speed limit of 30 mph with a 20 mph school zone near the school.

The project site is shown on Figure 1. **If our described understanding/interpretation of the proposed project is incorrect or project elements differ in any way from that expressed above, including changes to improvement locations, dimensions, orientations, loading conditions, elevations/grades, etc., and/or additional buildings/structures/site improvements are incorporated into this project, either after the original information was provided to us or after the date of this report, GROUND or another geotechnical engineer must be retained to re-evaluate the conclusions and parameters presented herein.**

ALIGNMENT CONDITIONS

At the time of our exploration, the subject portion of the alignment generally consisted of a two-lane asphalt paved roadway. Provided plans and utility locator markings indicate buried utilities were associated with the alignment. Utility potholes and patches associated with utility potholes were also noted along the alignment. The existing shoulder to the west of the existing driveway into the school facility was comparatively wider than the shoulder to the east. Ditches were also present along much of the subject alignment. The shoulders generally consisted of a strip of road base with short to medium grasses. Slopes generally descended moderately to steeply to the north from the alignment. Roadway grades generally sloped to the east and southeast

Man-made fill was encountered in the test holes during our exploration program, likely due to previous construction activities, grading, and utility installation that have occurred along the alignment. The exact extents, limits, and composition of any man-made fill were not determined as part of the scope of work addressed by this study, and should be expected to potentially exist at varying depths and locations across the site.

SUBSURFACE EXPLORATION

The subsurface exploration for the project was conducted on February 20, 2023. Four (4) test holes were drilled within the roadway alignment with a buggy-mounted drill rig. The test holes were advanced to depths ranging from approximately 2½ to 10½ feet below existing grades. Due to safety concerns associated with buried utilities, Test Holes P-1 and P-3 were necessary to be terminated at approximately 2½ feet below existing grades. The test holes were drilled to evaluate the subsurface conditions as well as to retrieve soil

samples for laboratory testing and analysis. A representative of GROUND directed the subsurface exploration, logged the test holes in the field, and prepared the samples for transport to our laboratory.

Samples of the subsurface materials were taken with a 1⅜-inch I.D. standard penetration test sampler. Sampling using a 2-inch I.D. Modified California-type liner sampler was attempted; however, due to the comparatively coarse, granular nature of the soils and nil to poor sample recovery with the Modified California-type liner sampler, the driven samples were obtained using the standard penetration test sampler. The samplers were driven into the substrata with blows from a 140-pound hammer falling 30 inches. This procedure is similar to the Standard Penetration Test described by ASTM Method D1586. Penetration resistance values (blows per distance driven), when properly evaluated, indicate the relative density or consistency of soils. A composite bulk sample was also obtained from the test hole auger cuttings. Depths at which the samples were taken, and associated penetration resistance values are shown on the test hole logs.

GROUND utilized the Client-provided site plan indicating existing features, Google Map imagery, and a hand-held GPS device to determine the locations of the test holes. The approximate locations of the test holes are shown in Figure 1. Summary logs are provided in Figure 2 and a legend and notes are provided in Figure 3. Detailed logs of the test holes are presented in Appendix A.

LABORATORY TESTING

Samples retrieved from our test holes were examined and visually classified in the laboratory by the project engineer. Laboratory testing of soil samples included standard property tests, such as natural moisture contents, grain-size analyses, and Atterberg limits. Water soluble sulfate testing was performed on selected samples. Classification, Proctor, and R-Value testing were also performed on a composite bulk sample. Swell-consolidation testing was not performed due to pervasive sample disturbance and the granular nature of the site soils.

Results of the laboratory testing program are summarized in Table 1, Appendix A, and Appendix B.

SUBSURFACE CONDITIONS

Geologic Setting Published geologic maps (Douglas, Reed, Bryant, 1972[1]) depict the project area as underlain by Upper Holocene Piney Creek Alluvium (**Qp**) and Precambrian Interlayered Hornblende Gneiss, Calc-Silicate Gneiss, and Amphibolite (**hcs**). The alluvial deposits are generally described to consist of humic silts and sands with gravels. The gneiss and amphibolite are generally described to consist of fine- to medium-grained gneisses and variably foliated amphibolite.

In the project area, alluvial (steam-laid) deposits typically consist of fine to coarse sands, gravels, cobbles, and boulders with local silts and clays. The larger clasts (cobbles and boulders) may be awkward or difficult to handle and may not be appropriate for use in all fills.

Gneiss is a heavily metamorphosed (deformed) rock characterized by foliation and mafic/felsic banding. The banding can be on various scales, ¼ inch or smaller to several feet or more. The foliations can create planes of weakness where relatively weaker minerals are layered together in a preferential orientation.

Amphibolite is a coarse-grained metamorphic rock.

Depending on several factors, including the level of weathering, minerology, deformation (i.e., jointing, fracturing, etc.), bedrock may require significant efforts to excavate and in some cases, require blasting, hammering, and/or other hard rock excavation techniques to excavate.

Local Subsurface Conditions GROUND grouped the retrieved soil samples based on their material type (fill or native). It is GROUND's opinion that grouping the soils based solely on AASHTO classification will be less useful in understanding the engineering characteristics of the subsurface conditions. The subsurface conditions encountered in the test holes generally consisted of approximately 5 to 7 inches of asphalt[2], underlain by approximately 3 inches of roadbase. These materials were underlain by fill which

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[1] Sheridan, Douglas. M., Reed, John. C., Byrant, Bruce (1972). *Geologic Map of the Evergreen Quadrangle, Jefferson County, Colorado*. United States Geological Survey.

[2] Pavement section thicknesses are difficult to determine with precision in small diameter test holes. If existing pavement section thicknesses are of significance to the project, then additional, larger diameter test holes or pavement cores should be drilled.

persisted to the depths explored in Test Holes P-1 and P-3. Fill was underlain by native sands and gravels in Test Holes P-2 and P-4 which were encountered at depths of approximately 3 and 2 feet below existing grades, respectively. The test holes extended to depths ranging from approximately 2½ to 10½ feet below existing grades.

The 1⅜-inch diameter sampling apparatus inherently cannot sample undisturbed cobble and boulder materials due to their larger size. It should be understood that the samples obtained during drilling operations may not be representative of the larger sized earth materials that may be encountered during construction. Material sizes and descriptions are largely interpreted based on drilling advancement rates and other observations during the drilling operations. Additional exploration utilizing alternate methods, such as test pits, should be considered if more information is desired.

At this site, therefore, it should be anticipated that gravels and cobbles, and possibly boulders, may be present in the site soils, even where not included in the general descriptions of the site soil types below.

FILL generally consisted of silty to clayey sands with gravels and sands with silts and gravels. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to slightly plastic, dry to slightly moist, and light brown to dark brown in color. Iron staining was noted locally.

It should be noted that the fill soils and native soils were relatively similar in composition. The delineation of the complete lateral and vertical extents of any fills at this site, or their compositions, was beyond our present scope of services. If fill soil volumes or compositions at the site are of significance, they should be further evaluated using test pits.

Silty to Clayey SANDS with Gravels generally consisted of slightly silty sands with gravels to silty to clayey sands with gravels. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to moderately plastic, loose to very dense, dry to slightly moist, and light brown to brown in color. Iron staining was noted locally.

Groundwater was not encountered in the test holes at the time of drilling. The test holes were backfilled upon drilling completion per Code of Colorado Regulations (2 CCR 402-

2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not constitute a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND should be contacted; additional exploration and fees will be necessary in this regard.

It has been our experience that surface and groundwater levels fluctuate greatly in mountainous areas, primarily due to seasonal conditions such as spring runoff. These conditions are often highly variable and difficult to predict. Although these conditions generally exist for a few months annually, their impact on design can be significant. In the project area, it is common during construction to encounter dry conditions in the fall and wet conditions in the spring with relative groundwater fluctuations of 10 feet or more. This is particularly critical for foundation and deep utility excavations, cut slopes, culvert sizing, and for development adjacent to intermittently dry streams, rivers, and wetlands.

WATER-SOLUBLE SULFATES

The concentration of water-soluble sulfates measured in selected samples of the site soils ranged from less than the detectable limit to 0.01 percent by weight (see Table 1). Such concentrations of soluble sulfates represent a **negligible** environment for sulfate attack on concrete exposed to these materials. Degrees of attack are based on the scale of 'negligible,' 'moderate,' 'severe' and 'very severe' as described in the “Design and Control of Concrete Mixtures,” published by the Portland Cement Association (PCA). The Colorado Department of Transportation (CDOT) utilizes a corresponding scale with 4 classes of severity of sulfate exposure (Class 0 to Class 3) as described in the published table below.

REQUIREMENTS TO PROTECT AGAINST DAMAGE TO CONCRETE BY SULFATE ATTACK FROM EXTERNAL SOURCES OF SULFATE

Severity of Sulfate Exposure	Water-Soluble Sulfate (SO_4) In Dry Soil *(%)*	Sulfate (SO_4) In Water *(ppm)*	Water Cementitious Ratio *(maximum)*	Cementitious Material Requirements
Class 0	0.00 to 0.10	0 to 150	0.45	Class 0
Class 1	0.11 to 0.20	151 to 1500	0.45	Class 1
Class 2	0.21 to 2.00	1501 to 10,000	0.45	Class 2
Class 3	2.01 or greater	10,001 or greater	0.40	Class 3

Based on our test results and PCA and CDOT guidelines, GROUND recommends the use of the appropriate cement in all concrete exposed to site soils, conforming to one of the following requirements:

Class 0 (Negligible)

1) ASTM C150 Type I, II, III, or V.

2) ASTM C595 Type IL, IP, IP(MS), IP(HS), or IT.

The contractor should be aware that certain concrete mix components affecting sulfate resistance including, but not limited to, the cement, entrained air, and fly ash, can affect workability, set time, and other characteristics during placement, finishing and curing. The contractor should develop mix(es) for use in project concrete which are suitable with regard to these construction factors, as well as sulfate resistance. A reduced, but still significant, sulfate resistance may be acceptable to the owner, in exchange for desired construction characteristics.

FROST HEAVE

According to the US Army Corps of Engineers manual (1965), the site soils classify as F3 materials. Therefore, even if surface drainage is effective, the likelihood of movement of pavements, sidewalks, and other hardscaping as a result of frost heave is relatively low to high, per the US Army Corps manual. Often times where frost heave is a concern, replacement of the subgrade soils with 3 or more feet granular material would be performed. However, due to the depth of the recently placed underground utilities, we understand that this may not be feasible. In GROUND's opinion, effective, positive surface

drainage and routine maintenance operations to seal any cracks that will allow moisture to infiltrate the soils may reduce the potential for frost heave.

PAVEMENT SECTIONS

A pavement section is a layered system designed to distribute concentrated traffic loads to the subgrade. Performance of the pavement structure is directly related to the physical properties of the subgrade soils and traffic loadings. Standard practice in pavement design describes a typical flexible pavement section as a "20-year" design; however, most pavements will not remain in satisfactory condition without routine maintenance and rehabilitation procedures performed throughout the life of the pavement.

The pavement section for Sugarbush Drive was developed in general accordance with the applicable design guidelines and procedures of the American Association of State Highway and Transportation Officials (AASHTO), the Jefferson County Transportation Design & Construction Manual (Jeffco Specifications), and the Colorado Department of Transportation (CDOT) 2021 Pavement Design Manual (CDOT specifications).

Subgrade Materials Based on the results of our field and laboratory studies, the subgrade materials encountered in our test holes were fills and native soils consisting generally of slightly silty sands with gravels to silty to clayey sands with gravels. These materials were classified predominantly as A-2-4 soils in accordance with the AASHTO classification system. The soils encountered in Test Hole P-4 classified as A-1-a.

A composite bulk sample from the test holes was collected and R-Value testing was performed on that sample. R-Value testing yielded a result of 51 at a 300 psi exudation pressure.

It is important to note that significant decreases in soil support have been observed as the moisture content increases above the optimum. Therefore, pavements that are not properly drained may experience a loss of the soil support and subsequent reduction in pavement life.

As discussed, fills ranging up to approximately 3 feet are anticipated to be necessary to facilitate the proposed roadway widening. Any imported soils to the site should be similar in composition to the existing site soils and must meet the criteria discussed herein if the pavement sections provided herein are to be utilized. **Furthermore, Jeffco**

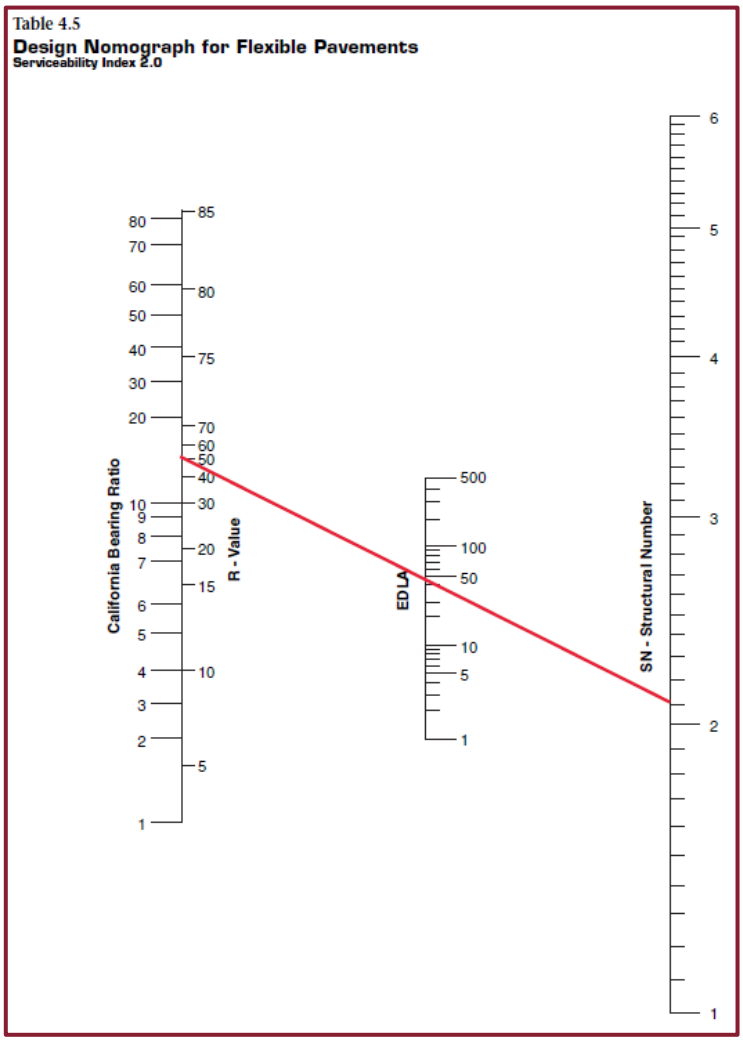
Specifications state that, "All soil samples must be taken after overlot grading, or represent the "as-constructed" soil conditions after construction has been completed. Therefore, additional geotechnical evaluation may be necessary to develop final pavement sections for the proposed widening.

Design Traffic As stated, GROUND was provided with a traffic impact analysis report prepared by LSC Transportation Consultants, Inc. for this project. Based on Figure 2 of the traffic memorandum (Year 2042 Total Traffic, Lane Geometry and Traffic Control), an average daily traffic volume (ADT) of 4,800 for year 2042 was provided for Sugarbush Drive at a location west of its intersection with Stone Canyon Road. ADT volumes of 735 and 450 were also provided for the existing and proposed facility driveways, respectively. While it may be possible that a lower ADT volume may be applicable for the subject portion of Sugarbush Drive given the residential and other developments serviced by it near the provided volume, the provided volume was utilized herein.

As discussed, we understand Sugarbush Drive will be widened to add left turn lanes near the existing and proposed facility driveways resulting in a three-lane roadway. Provided information also indicated the roadway classification is Local. Detailed information regarding the anticipated vehicle distribution for the subject roadway was unavailable at the time of this report preparation. The traffic impact analysis report indicated 2 percent heavy vehicles; we assumed a mixture of traffic consisting of 98 percent passenger cars/pickups, 1 percent single-unit trucks, and 1 percent heavy/combination trucks. Load equivalency factors were based on CDOT specifications (Appendix H, Table H.2). Based on this information and utilizing a lane configuration of 0.60 for a three-lane roadway, an equivalent (18 kip) daily load application (EDLA) of 47 was determined.

Jefferson County and the Client should review the above design values, based on their knowledge and understanding of the roadway and current/potential use characteristics. If design traffic loadings differ significantly from these developed values, the pavement sections provided below should be re-evaluated.

Pavement Design Per Jeffco Specifications, a serviceability index of 2.0 (local roadway classification) was utilized. Strength coefficients for flexible pavement design were obtained from Table 4.4 of the Jeffco Specifications. A coefficient of 0.40 was utilized for hot mix asphalt and 0.12 was utilized for aggregate base course. A design nomograph provided on Table 4.5 (Design Nomograph for Pavements) from the Jeffco Specifications was utilized to develop the **required structural number of 2.12** (nomograph shown to the right). Thickness design of the pavement structure was performed using the equation SN = a1D1 + a2D2 where SN is the structural number; a1 and a2 are the strength coefficients of the pavement section materials; and D1 and D2 are the thicknesses of the pavement section materials.



CALCULATED MINIMUM PAVEMENT SECTIONS

	Minimum Full Depth Section *(inches HMA)*	**Minimum Composite Section** (inches HMA / inches ABC)
Section Thicknesses	5½	3½ / 6
Design Structural Number	(5½ x 0.4) = 2.2	(3½ x 0.4) + (6 x 0.12) = 2.12

HMA = Hot-Mix Asphalt, ABC = Aggregate Base Course

The calculated minimum pavement section thicknesses presented above are thinner than the existing pavement thicknesses measured in the majority of the test holes. In GROUND's opinion, the new pavement should generally meet or exceed the existing pavement section thicknesses.

Pavement Properties

Hot-Mix Asphalt (HMA): The asphalt pavement shall consist of a bituminous plant mix composed of a mixture of high-quality aggregate and bituminous material.

Per Table 6.9 of the CDOT Pavement Design Manual, the asphalt material used should be based on a SuperPave Gyratory Design Revolution (N_{DES}) of 75 (ESALS ranging from 300,000 to 1,000,000). Per LTTP-Bind V3.1, PG 58-28 asphalt cement binder is acceptable. Pavement lift thicknesses should be between 2 to 4¼ inches (Grade S) and 1½ to 2½ inches for the top lift (SX, if utilized). Note that the suggested pavement binders could be adjusted depending on the market condition at the time of construction. Alternate binder types should be submitted for review and approval prior to construction. The asphalt cement selected for the proposed pavement section should ultimately conform to requirements outlined in the Jeffco Specifications.

Aggregate Base Course (ABC): The aggregate base material should meet the criteria of CDOT Class 6 aggregate base course. Base course should be placed in uniform lifts not exceeding 8 inches in loose thickness and compacted to at least 95 percent of the maximum dry density a uniform moisture contents within 2 percent of the optimum as determined by ASTM D1557 / AASHTO T-180, the "modified Proctor." The aggregate base course material should have either a California Bearing Ratio (CBR) greater than 80 or an R-value greater than 78.

Pavement Subgrade Preparation

Remedial earthwork to any depth will not prevent pavement distress on these soils, but will tend to reduce it and improve perceived rideability.

Remedial Earthwork Where undocumented fill soils are present beneath proposed pavement areas, all of the fill soils should be removed and replaced as properly compacted fill. We understand; however, that it may not be practical remove and replace the fill soils to their full depths or soft, yielding, or otherwise deleterious soils as properly compacted

fill due the presence of utility lines and the proximity of existing improvements. Therefore, if the Owner opts to reduce the fill section beneath the pavements, additional post-construction movements, accelerated pavement distress, and additional maintenance should be anticipated. We suggest remedial earthwork should be performed to no less than 12 inches in such a case. Similarly, where existing utility lines or other site constraints limit the depth to which remedial earthwork can be accomplished, additional maintenance should be anticipated.

This section assumes that significant total and differential pavement post-construction movements (on the order of several inches) and the associated maintenance costs that are necessary to re-establish effective drainage, replace distressed pavement, etc. are acceptable.

Fill Placement

It is GROUND's opinion that the subgrade preparation associated with the pavement should also extend from back of curb to back of curb, in the event curb and gutter is incorporated into the construction. In the event of attached sidewalks, the subgrade preparation should ideally extend from back of sidewalk to back of sidewalk. The potential for pavement distress as a result of both heave and settlement still exists after properly following the pavement subgrade preparation provided in this report. Increased depths/thicknesses may further reduce post-construction distress.

Immediately prior to paving, the subgrade should be proof rolled with a heavily loaded, pneumatic tired vehicle. Areas that show excessive deflection during proof rolling should be excavated and replaced and/or stabilized. Areas allowed to pond prior to paving will require significant re-working prior to proof-rolling. All subgrade preparation must ultimately comply with roadway inspection, testing, and construction procedures outlined in the Jeffco Specifications.

The proposed alignment contains existing shallow-buried utilities. The contractor should be aware that additional care should be taken when working in these areas. In the event the subgrade materials are significantly disturbed or require moisture-density treatment, recompaction over/adjacent to these utilities may be very difficult, possibly resulting in the utilization of concrete or flow fill in order to properly prepare the subgrade area for paving.

As applicable, site grading should be performed as early as possible in the construction sequence to allow settlement of fills and surcharged ground to be realized to the greatest extent prior to subsequent construction.

Prior to earthwork construction, vegetation and other deleterious materials should be removed and disposed of off-site. Relic underground utilities should be abandoned in accordance with applicable regulations, removed as necessary, and properly capped.

Topsoil present on-site should not be incorporated into ordinary fills. Instead, topsoil should be stockpiled during initial grading operations for placement in areas to be landscaped or for other approved uses.

Existing Fill Soils Fill materials were recognized in the test holes during subsurface exploration and are likely are present elsewhere on the site. Because not all the fill soils were sampled and tested, it is possible that some of the fill soils may not be suitable for re-use as compacted fill, due to the presence of deleterious materials such as trash, organic material, coarse cobbles and boulders, or construction debris. Therefore, excavated fill materials should be evaluated and tested, as appropriate, with regard to re-use. Fragments of rock and cobbles larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills (see subsection below for additional discussion in this regard.

Use of Existing Native Soils Overburden soils are suitable, in general, for placement as compacted fill. Organic materials should not be incorporated into project fills. Fragments of rock and cobbles larger than 3 inches in maximum dimension will require special handling and/or placement to be incorporated into project fills. Such fragments should not consist of non-durable sedimentary bedrock materials (i.e., siltstone, claystone, or sandstone bedrock). In general, such materials should be placed as deeply as possible in the project fills. A Geotechnical Engineer should be consulted regarding appropriate guidance for usage of such materials on a case-by-case basis when such materials have been identified during earthwork. Standard recommendations that likely will be generally applicable can be found in Section 203 of the current CDOT Standard Specifications for Road and Bridge Construction.

Imported Fill Materials If it is necessary to import material to the site, the imported soils should be free of organic material, and other deleterious materials. **Imported material**

should consist of soils that have less than 25 percent passing the No. 200 Sieve and should have a plasticity index less than 5. The R-Value at a 300 psi exudation pressure must be 51 or greater for any imported fills used in the roadway subgrade. Representative samples of the materials proposed for import should be tested and approved prior to transport to the site.

Fill Platform Preparation Prior to filling, the top 8 to 12 inches of in-place materials on which fill soils will be placed should be scarified, moisture conditioned and properly compacted in accordance with the parameters below to provide a uniform base for fill placement. *If over-excavation is to be performed, then these parameters for subgrade preparation are for the subgrade **below the bottom** of the specified over-excavation depth.*

If surfaces to receive fill expose loose, wet, soft or otherwise deleterious material, additional material should be excavated, or other measures taken to establish a firm platform for filling. The surfaces to receive fill must be effectively stable prior to placement of fill.

Fill Placement Fill materials should be thoroughly mixed to achieve a uniform moisture content, placed in uniform lifts not exceeding 8 inches in loose thickness, and properly compacted.

Soils that classify as GP, GW, GM, GC, SP, SW, SM, or SC in accordance with the USCS classification system (granular materials) should be compacted to **95 or more percent** of the maximum modified Proctor dry density at moisture contents **within 2 percent of optimum moisture content** as determined by ASTM D1557.

No fill materials should be placed, worked, rolled while they are frozen, thawing, or during poor/inclement weather conditions.

Care should be taken with regard to achieving and maintaining proper moisture contents during placement and compaction. Materials that are not properly moisture conditioned may exhibit significant pumping, rutting, and deflection at moisture contents near optimum and above. The contractor should be prepared to handle soils of this type, including the use of chemical stabilization, if necessary.

Compaction areas should be kept separate, and no lift should be covered by another until relative compaction and moisture content within the suggested ranges are obtained.

Additional Observations

The collection and diversion of surface drainage away from paved areas is extremely important to satisfactory performance of the pavements. The subsurface and surface drainage systems should be carefully designed to ensure removal of the water from paved areas and subgrade soils. Allowing surface waters to pond on pavements will cause premature pavement deterioration. Where topography, site constraints or other factors limit or preclude adequate surface drainage, pavements should be provided with edge drains to reduce loss of subgrade support.

GROUND's experience indicates that longitudinal cracking is common in asphalt-pavements generally parallel to the interface between the asphalt and concrete structures such as curbs, gutters or drain pans. Distress of this type is likely to occur even where the subgrade has been prepared properly and the asphalt has been compacted properly.

The standard care of practice in pavement design describes the flexible pavement section as a "20-year" design pavement; however, most pavements will not remain in satisfactory condition without routine, preventive maintenance and rehabilitation procedures performed throughout the life of the pavement. Preventive pavement treatments are surface rehabilitation and operations applied to improve or extend the functional life of a pavement. These treatments preserve, rather than improve, the structural capacity of the pavement structure. In the event the existing pavement is not structurally sound, the preventive maintenance will have no long-lasting effect. Therefore, a routine maintenance program to seal cracks, repair distressed areas, and perform thin overlays throughout the life of the pavement is suggested.

A crack sealing and fog seal / chip seal program should be performed on flexible pavements on a regular basis. After approximately 8 to 10 years, patching, additional crack sealing, and asphalt overlay may be required. Prior to future overlays, it is important that all transverse and longitudinal cracks be sealed with a flexible, rubberized crack sealant in order to reduce the potential for propagation of the crack through the overlay. Concrete pavements will likely require grinding and localized panel replacement. Traffic volumes that exceed the values utilized by this report will likely necessitate the need of

pavement maintenance practices on a schedule of shorter timeframe than that stated above. The greatest benefit of preventive maintenance is achieved by placing the treatments on sound pavements that have little or no distress.

RETAINING WALLS

As discussed, we understand retaining walls are planned. Based on the data obtained, we can provide the following preliminary information regarding site retaining walls. Depending on the final locations and heights of the walls, additional geotechnical evaluation may be necessary and may indicate that different parameters are appropriate.

Preliminarily, both cantilevered walls and mechanically stabilized earth (MSE) walls appear feasible at this site to support the proposed grade changes. However, given that MSE walls are more tolerant of post-construction movements, MSE walls may be more practical at this site. We also understand MSE wall are currently planned by the Design Team.

MSE Walls An MSE wall system will bear at shallow depths but is flexible and, in our experience, will be relatively tolerant of total and differential post-construction movements. Therefore, an MSE wall should bear on a section of properly compacted fill, native soils or bedrock. Structure backfill (CDOT Class 1) should be utilized within the reinforced backfill zone of MSE walls. Geotechnical parameters for fill placement and compaction are provided in the *Project Earthwork* section of this report. It must be understood that an MSE wall will move after completion and that movement generally will be noticeably differential.

Bearing capacity for an MSE retaining wall should be developed by the wall designer based on the width of the wall reinforced zone using the parameters presented below for retaining wall design and Meyerhoff or other appropriate bearing capacity methods. Movement potential and services limit states should be evaluated by the wall designer based on the soil conditions and anticipated wall bearing pressure. If soil improvements for bearing capacity and/or service limits are considered necessary, a geotechnical engineer should be retained to provide additional parameters and considerations.

Based on the available geotechnical data, we preliminarily anticipate that the wall subgrade materials will typically consist of fills and/or native silty to clayey sands with

gravels. The estimated soil parameters for use in the retaining wall planning and preliminary design are summarized in the following table.

Material Type	Moist Unit Weight *(pcf)*	Internal Friction Angle *(degrees)*
FILLS	130	24
Silty to Clayey SANDS with Gravels	130	26
CDOT Class 1 Structure Backfill	135	34

Additional Retaining Wall Considerations Retaining walls should be provided with drains at the toe of the walls, or with weep holes, to help reduce the development of hydrostatic loads and water infiltration to the subgrade soils. A properly constructed wall drain system should be included in the retaining walls. Drainage systems in retaining walls are intended to collect and divert water infiltration or natural seepage.

In addition to surrounding the drain pipes with at least 6 inches of free-draining gravel, the gravel should extend upward to within 12 inches of the backfill surface behind the wall or the wall should be backed with a layer of geocomposite drainage medium, e.g., an appropriate MiraDrain® product or approved equivalent. The gravel or drainage product backing the wall should be in hydraulic connection with the wall toe drain. If gravel backfill is selected, it should be separated from the enclosing soils by a layer of filter fabric to reduce the migration of fines into the gravel.

Wall drain systems are typically not intended to handle surface runoff or concentrated water at the top of walls, which should be collected and diverted by properly designed and constructed storm drainage features. The areas surrounding the retaining walls should be carefully graded to provide positive surface drainage away from the walls. Landscape irrigation around retaining walls should be reduced to a minimum throughout the life of the retaining walls. The wall systems and the surrounding areas must be kept relatively dry at all times during and after the construction to prevent water from infiltrating into the wall systems. In no case shall surface runoff be allowed to enter the wall construction areas, or water be allowed to pond above the walls. Temporary and permanent slopes and other

stripped areas shall be adequately protected against erosion. Erosion along walls and slopes will result in sloughing and could lead to a wall failure.

We were unaware of the retaining wall system planned at the site at the time of this report preparation. As discussed, MSE walls are flexible retention systems, and should be anticipated to move both laterally and vertically after construction. If surface improvements, such as flatworks, sidewalks, curbs and gutters, pavements, fences, guardrails, utility pads, storm features, and manholes are installed near the walls, the anticipated wall movement often results in movement of the nearby surface improvements. Surface runoff infiltrating through joints of these surface improvements into wall backfill can aggravate movements of these surface improvements and the walls. Therefore, surface improvements and storm features should be located away from the wall systems. All of the joints of surface improvements must be properly sealed and maintained throughout the life of the wall systems.

Underground wet utility lines, such as waterlines, storm sewers, sanitary sewers, irrigation lines, and water features installed within or near retaining wall backfill are susceptible to leaks due to potential wall movements. Utility line leaks can also induce retaining wall movements and result in wall failures. Therefore, we strongly recommend that wet utility lines be installed away from retaining wall systems. In the event that wet utility lines or water features are installed within or near retaining wall backfill, the bottom of utility trenches or water features shall be properly lined to prevent water from infiltrating into the wall systems.

EXCAVATION CONSIDERATIONS

Excavation Difficulty: Test holes for the subsurface exploration were advanced to the depths indicated on the test hole logs by means of conventional, buggy-mounted, continuous flight solid-stem auger drilling equipment. Given the inherent nature of fill soils, materials that may be awkward or otherwise difficult to handle (e.g., relatively large pieces of construction debris, cobbles, and boulders) may be encountered in the existing fill soils. The contractor and project team should be prepared to excavate, handle, and export such materials if encountered in the site soils. These materials should not be considered as an “unforeseen condition” at the time of construction.

In addition, relatively large cobbles and/or boulders may be encountered within the native soils as well. Again, the contractor and the project team should be prepared to excavate, handle, and possibly export such materials in the site soils.

Additionally, where encountered elsewhere at the site, the site bedrock was generally very hard. If encountered, the contractor and project team should anticipate some of the site bedrock will be very hard and require greater than typical efforts to excavate. Blasting or the use of a hydraulic hammer may be necessary to excavate the site bedrock.

Groundwater Groundwater was not encountered in the test holes at the time of drilling. The test holes were backfilled upon drilling completion per Code of Colorado Regulations (2 CCR 402-2). Groundwater levels can be expected to fluctuate, however, in response to annual and longer-term cycles of precipitation, irrigation, surface drainage, nearby rivers and creeks, land use, and the development of transient, perched water conditions. The groundwater observations performed during our exploration must be interpreted carefully as they are short-term and do not constitute a groundwater study. In the event the Client desires additional/repeated groundwater level observations, GROUND

It is possible that groundwater may be encountered in project excavations at depths both shallower and deeper than those indicated above. The contractor should be prepared to dewater excavations during construction. Pumps adequate to discharge water and/or well points to draw down the water level may be appropriate methods. Other methods may also be necessary. The dewatering approach should ultimately be determined by the contractor based on their means and methods experience. Dewatering operations may be necessary as both temporary and long-term/permanent installations. If seepage or groundwater is encountered during excavation or at any time during construction, the Geotechnical Engineer and project team should be contacted to evaluate the conditions. The presence of groundwater in these types of situations and associated potential design changes can have an impact to both the financial and schedule components of a project.

Temporary Excavations and Personnel Safety Excavations in which personnel will be working must comply with all applicable OSHA Standards and Regulations, particularly CFR 29 Part 1926, OSHA Standards-Excavations, adopted March 5, 1990. The contractors “responsible person” should evaluate the soil exposed in the excavations as part of the contractor’s safety procedures. GROUND has provided the information in this

report solely as a service to the Client and is not assuming responsibility for construction site safety or the contractor's activities.

The contractor should take care when making excavations not to compromise the bearing or lateral support for any adjacent, existing improvements.

Temporary, un-shored excavation slopes up to 10 feet in height be cut no steeper than 1½:1 (horizontal : vertical) in the site soils in the absence of seepage. Some surface sloughing may occur on the slope faces at these angles. Local conditions encountered during construction, such as groundwater seepage and loose sand, will require flatter slopes. Stockpiling of materials should not be permitted closer to the tops of temporary slopes than 5 feet or a distance equal to the depth of the excavation, whichever is greater.

Should site constraints prohibit the use of the slope angles, temporary shoring should be used. The shoring should be designed to resist the lateral earth pressure exerted by buildings, improvements, traffic, equipment, stockpiles, etc.

Surface Water The contractor should take pro-active measures to control surface waters during construction and maintain good surface drainage conditions to direct waters away from excavations and into proper drainage structures. A properly designed drainage swale should be provided at the top of the excavations. In no case should water be allowed to pond at the site. Slopes should also be protected against erosion. Erosion along the slopes will result in sloughing and could lead to a slope failure.

CLOSURE

Geotechnical Review The author of this report or a GROUND principal should be retained to review project plans and specifications to evaluate whether they comply with the intent of the measures discussed in this report. The review should be requested in writing.

The geotechnical conclusions and parameters presented in this report are contingent upon observation and testing of project earthwork by representatives of GROUND. If another geotechnical consultant is selected to provide materials testing, then that consultant must assume all responsibility for the geotechnical aspects of the project by concurring in writing with the parameters in this report, or by providing alternative parameters.

Materials Testing Jeffco Public Schools should consider retaining a geotechnical engineer to perform materials testing during construction. The performance of such testing or lack thereof, however, in no way alleviates the burden of the contractor or subcontractor from constructing in a manner that conforms to applicable project documents and industry standards. The contractor or pertinent subcontractor is ultimately responsible for managing the quality of his work; furthermore, testing by the geotechnical engineer does not preclude the contractor from obtaining or providing whatever services that he deems necessary to complete the project in accordance with applicable documents.

Limitations This report has been prepared for Jeffco Public Schools as it pertains to the design of the subject portion of Sugarbush Drive near the Bergen Valley Elementary School, as described herein. It should not be assumed to contain sufficient information for other parties or other purposes. The Client has agreed to the terms, conditions, and liability limitations outlined in our proposal between Jeffco Public Schools and GROUND. Reliance upon our report is not granted to any other potential owner, contractor, or lender.

In addition, GROUND has assumed that project construction will commence by spring 2024 and end within 1 year of the project commencement date. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this report may be re-evaluated and, as necessary, modified.

The geotechnical conclusions and parameters in this report were based on subsurface information from a limited number of exploration points, as shown in *Figure 1*, as well as the means and methods described herein. Subsurface conditions were interpolated between and extrapolated beyond these locations. It is not possible to guarantee the subsurface conditions are as indicated in this report. Actual conditions exposed during construction may differ from those encountered during site exploration. Design modifications may be necessary by the project team; this may result in an increase in project costs and schedule delays. In addition, a contractor who obtains information from this report for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this report to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional

geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes, but is not limited to, information regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, work should cease and a geotechnical engineer should be retained at once, so that our conclusions and design parameters for this site may be re-evaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed structure and pavement will depend on implementation of the conclusions and information in this report and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements, some of which will exceed estimates provided herein and should therefore be expected by Jeffco Public Schools.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this report, as well as the estimated performance (and limitations with any such estimations) of proposed improvements are understood by Jeffco Public Schools. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this report by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that Jeffco Public Schools or the owner contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks and remedial approaches presented in this report, as well as other potential approaches, upon request.

Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect**.**

This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

GROUND appreciates the opportunity to complete this portion of the project and welcomes the opportunity to provide Jeffco Public Schools or the Owner with a proposal for construction observation and materials testing.

Sincerely,
GROUND Engineering Consultants, Inc.

Brian J. Knecht, P.G.

Reviewed by Jason A. Smith, REM, P.E.

GOOGLE EARTH AERIAL IMAGE (06/10/2021)

P-4 Indicates test hole numbers and approximate locations.

NOT TO SCALE

GROUND ENGINEERING

JOB NO.: 22-3677B

FIGURE: 1

LOCATION OF TEST HOLES

GROUND ENGINEERING

LOGS OF THE TEST HOLES

CLIENT: Jeffco Public Schools

JOB NO: 22-3677B

PROJECT NAME: Bergen Valley ES - Sugarbush Dr. Improvements

PROJECT LOCATION: Evergreen, CO

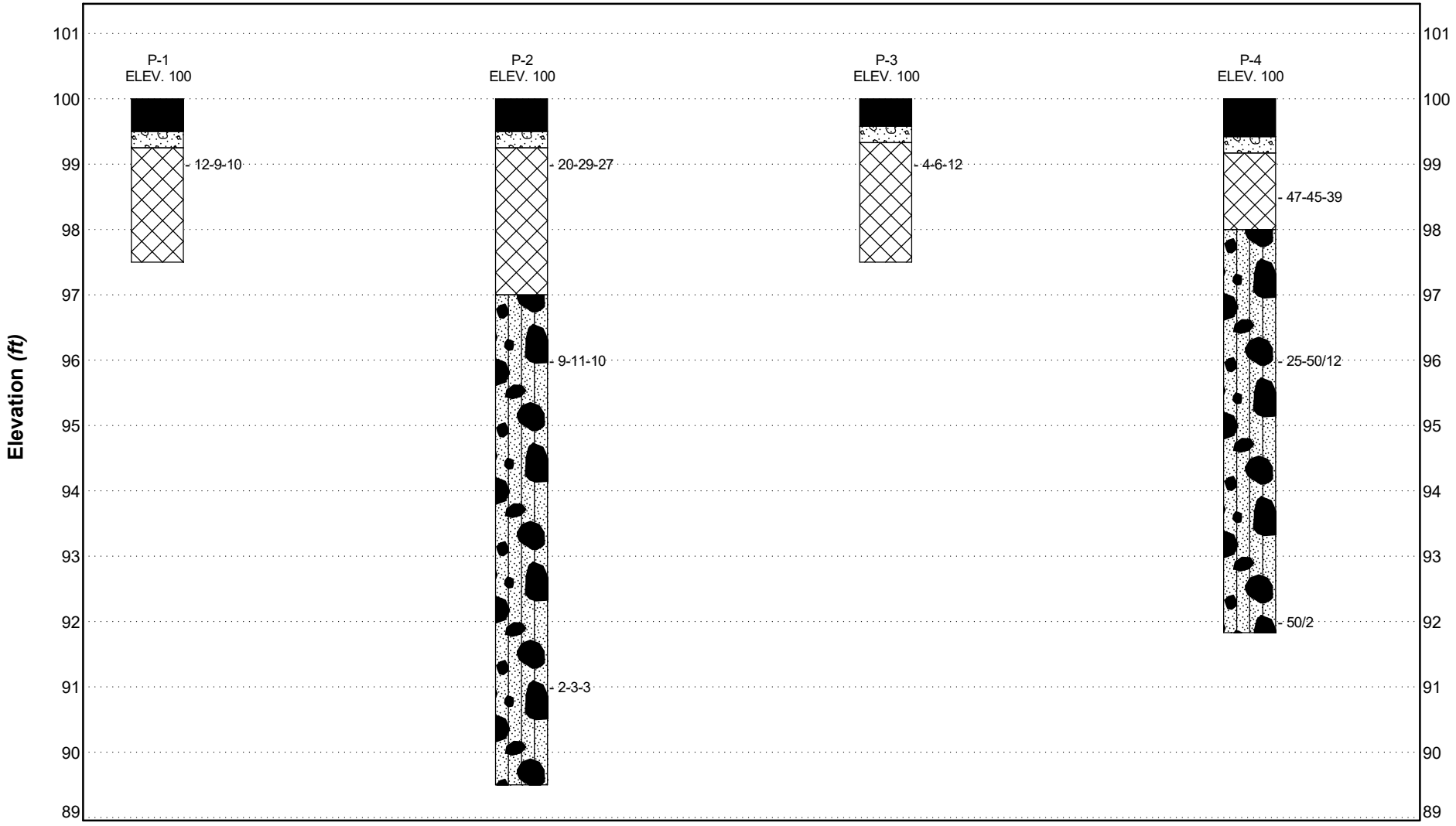


FIGURE: 2

LEGEND AND NOTES

GROUND ENGINEERING

CLIENT: Jeffco Public Schools **PROJECT NAME:** Bergen Valley ES - Sugarbush Dr. Improvements

JOB NO: 22-3677B **PROJECT LOCATION:** Evergreen, CO

MATERIAL SYMBOLS

ASPHALT

ROAD BASE

FILL

Silty to Clayey SANDS with Gravels

NOTE: See Detailed Logs for Material descriptions.

SAMPLER SYMBOLS

No Recovery

Standard Penetration Test Sampler
20-25-30 Drive sample blow count, indicates 20, 25, and 30 blows of a 140 pound hammer falling 30 inches were required to drive the sampler 18 inches in three 6 inch increments.

NOTES

1. Test holes were drilled on 2/20/2023 with 4" Solid Stem Auger.

2. Locations of the test holes were determined approximately by pacing from features shown on the site plan provided.

3. Elevations of test holes were estimated from client provided documents and the logs of test holes are hung to elevation.

4. The test hole locations and elevations should be considered accurate only to the degree implied by the method used.

5. The lines between materials shown on the test hole logs represent the approximate boundaries between material types and the transitions may be gradual.

6. Groundwater level readings shown on the logs were made at the time and under the conditions indicated. Fluctuations in the water level may occur with time.

7. The material descriptions on these logs are for general classification purposes only. See full text of this report for descriptions of the site materials & related information.

8. All test holes were immediately backfilled upon completion of drilling, unless otherwise specified in this report.

ABBREVIATIONS

▽ Water Level at Time of Drilling, or as Shown

▼ Water Level at End of Drilling, or as Shown

▼ Water Level After 24 Hours, or as Shown

NV	No Value
NP	Non-Plastic

FIGURE: 3

GROUND ENGINEERING

Bergen Valley Elementary School - Sugarbush Drive Improvements

TABLE 1: SUMMARY OF LABORATORY TEST RESULTS

Sample Location		Natural Moisture Content	Natural Dry Density	Gradation			Atterberg Limits		Water Soluble Sulfates	USCS Equivalent Classification	AASHTO Equivalent Classification (Group Index)	Sample Description
Test Hole No.	Depth (feet)	(%)	(pcf)	Gravel (%)	Sand (%)	Fines (%)	Liquid Limit	Plasticity Index	(%)			
P-1	1	7.2	*SD*	12	62	26.5	22	5	-	SC-SM	A-2-4 (0)	FILL: Silty, Clayey SAND
P-2	1	7.0	*SD*	19	59	22.3	25	6	< 0.01	(SC-SM)g	A-2-4 (0)	FILL: Silty, Clayey SAND with Gravel
P-2	9	11.0	*SD*	5	67	27.9	32	13	-	SC	A-2-6 (0)	Clayey SAND
P-3	1	7.6	*SD*	22	58	19.8	24	5	0.01	(SC-SM)g	A-2-4 (0)	FILL: Silty, Clayey SAND with Gravel
P-4	1.5	2.8	*SD*	43	48	8.6	*NV*	*NP*	-	(SP-SM)g	A-1-a (0)	FILL: SAND with Silt and Gravel
P-4	4	3.4	*SD*	38	52	10.0	*NV*	*NP*	-	(SP-SM)g	A-1-a (0)	SAND with Silt and Gravel
R-Value												
P-1 - P-4	0 - 5*	9.6**	124.6**	12	61	27.3	27	7	51	SC-SM	A-2-4 (0)	Silty, Clayey SAND

*SD = Sample disturbed, NV = No value, NP = Non-plastic, * Indicates 5 feet in Test Holes P-2 and P-4 and maximum depths explored in P-1 and P-3*

Job No. 22-3677B

*** Indicates optimum moisture content and maximum modified proctor density (ASTM D1557)*

APPENDIX A

Detailed Logs of the Test Holes

GROUND ENGINEERING

TEST HOLE P-1

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Sugarbush Dr. Improvements

JOB NO: 22-3677B

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
100.0	0.0		**ASPHALT:** Approximately 6 inches of asphalt.										
			ROAD BASE: Approximately 3 inches of aggregate base course.										
			FILL: Silty to clayey sands with gravels and sands with silt and gravel. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to slightly plastic, dry to slightly moist, and light brown to dark brown in color. Iron staining was noted locally.		12-9-10	7.2	SD	12	62	26	22	5	SC-SM
97.5	2.5												

Bottom of borehole at Approx. 2.5 feet.

GROUND ENGINEERING

TEST HOLE P-2

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Sugarbush Dr. Improvements

JOB NO: 22-3677B

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
100.0	0.0		**ASPHALT:** Approximately 6 inches of asphalt.										
			ROAD BASE: Approximately 3 inches of aggregate base course.										
			FILL: Silty to clayey sands with gravels and sands with silt and gravel. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to slightly plastic, dry to slightly moist, and light brown to dark brown in color. Iron staining was noted locally.		20-29-27	7	SD	19	59	22	25	6	(SC-SM)g
97.5	2.5												
			Silty to Clayey SANDS with Gravels: Slightly silty sands with gravels to silty to clayey sands with gravels. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to moderately plastic, loose to very dense, dry to slightly moist, and light brown to brown in color. Iron staining was noted locally.		9-11-10								
95.0	5.0												
92.5	7.5												
90.0	10.0				2-3-3	11	SD	5	67	28	32	13	SC

Bottom of borehole at Approx. 10.5 feet.

GROUND ENGINEERING

TEST HOLE P-3

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Sugarbush Dr. Improvements

JOB NO: 22-3677B

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
100.0	0.0		**ASPHALT:** Approximately 5 inches of asphalt.										
			ROAD BASE: Approximately 3 inches of aggregate base course.										
			FILL: Silty to clayey sands with gravels and sands with silt and gravel. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to slightly plastic, dry to slightly moist, and light brown to dark brown in color. Iron staining was noted locally.		4-6-12	7.6	SD	22	58	20	24	5	(SC-SM)g
97.5	2.5												

Bottom of borehole at Approx. 2.5 feet.

GROUND ENGINEERING

TEST HOLE P-4

CLIENT: Jeffco Public Schools

PROJECT NAME: Bergen Valley ES - Sugarbush Dr. Improvements

JOB NO: 22-3677B

PROJECT LOCATION: Evergreen, CO

Elevation (ft)	Depth (ft)	Graphic Log	Material Descriptions and Drilling Notes	Sample Type	Blow Count	Natural Moisture Content (%)	Natural Dry Density (pcf)	Gradation			Atterberg Limits		USCS
								Gravel %	Sand %	Fines %	Liquid Limit	Plasticity Index	
100.0	0.0		**ASPHALT:** Approximately 7 inches of asphalt.										
			ROAD BASE: Approximately 3 inches of aggregate base course.										
			FILL: Silty to clayey sands with gravels and sands with silt and gravel. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to slightly plastic, dry to slightly moist, and light brown to dark brown in color. Iron staining was noted locally.										
				X	47-45-39	2.8	SD	43	48	9	NV	NP	(SP-SM)g
97.5	2.5		**Silty to Clayey SANDS with Gravels:** Slightly silty sands with gravels to silty to clayey sands with gravels. The granular fractions were fine to coarse sands and gravels with scattered cobbles and boulders. They were non- to moderately plastic, loose to very dense, dry to slightly moist, and light brown to brown in color. Iron staining was noted locally.										
				X	25-50/12	3.4	SD	38	52	10	NV	NP	(SP-SM)g
95.0	5.0												
				○	50/2								
92.5	7.5												

Bottom of borehole at Approx. 8.17 feet.

APPENDIX B

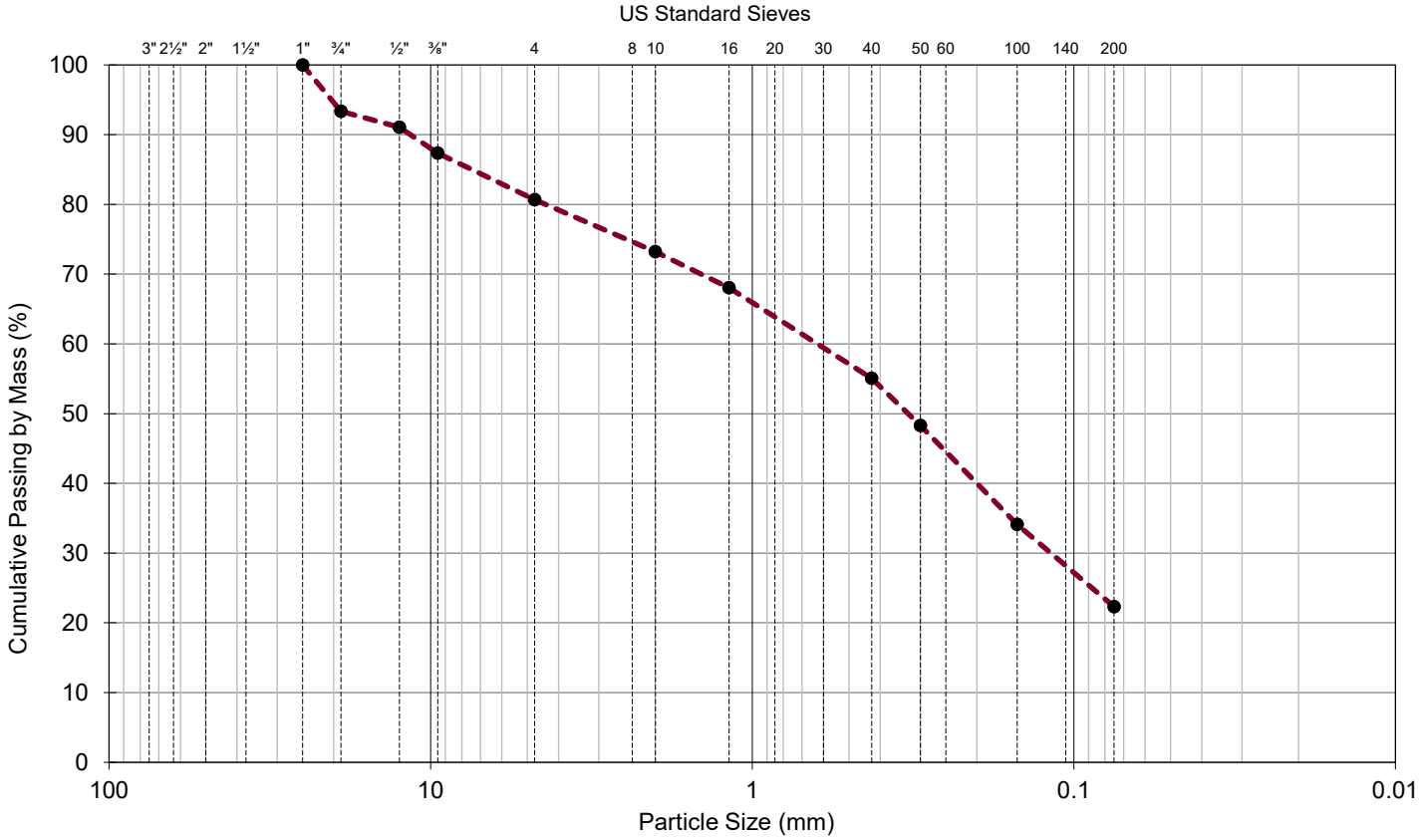
Laboratory Test Results

GROUND ENGINEERING

Project No.: 22-3677B

Bergen Valley Elementary School
Sugarbush Drive Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	81	D90	11.554
5 in	125	-	No. 8	2.36	-	D85	7.450
4 in	100	-	No. 10	2.00	73	D80	4.396
3 in	75	-	No. 16	1.18	68	D60	0.627
2.5 in	63	-	No. 20	0.85	-	D50	0.328
2 in	50	-	No. 30	0.60	-	D40	0.200
1.5 in	37.5	-	No. 40	0.425	55	D30	0.118
1 in	25.0	100	No. 50	0.300	48	D15	-
3/4 in	19.0	93	No. 60	0.250	-	D10	-
1/2 in	12.5	91	No. 100	0.150	34	D05	-
3/8 in	9.5	87	No. 140	0.106	-	Cu	-
No. 4	4.75	81	No. 200	0.075	22.3	Cc	-

Location: P-2 at 1 feet
Description: FILL: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-2-4 (0)
Liquid Limit: 25
Plasticity Index: 6

Gravel (%): 19
Sand (%): 59
Silt/Clay (%): 22

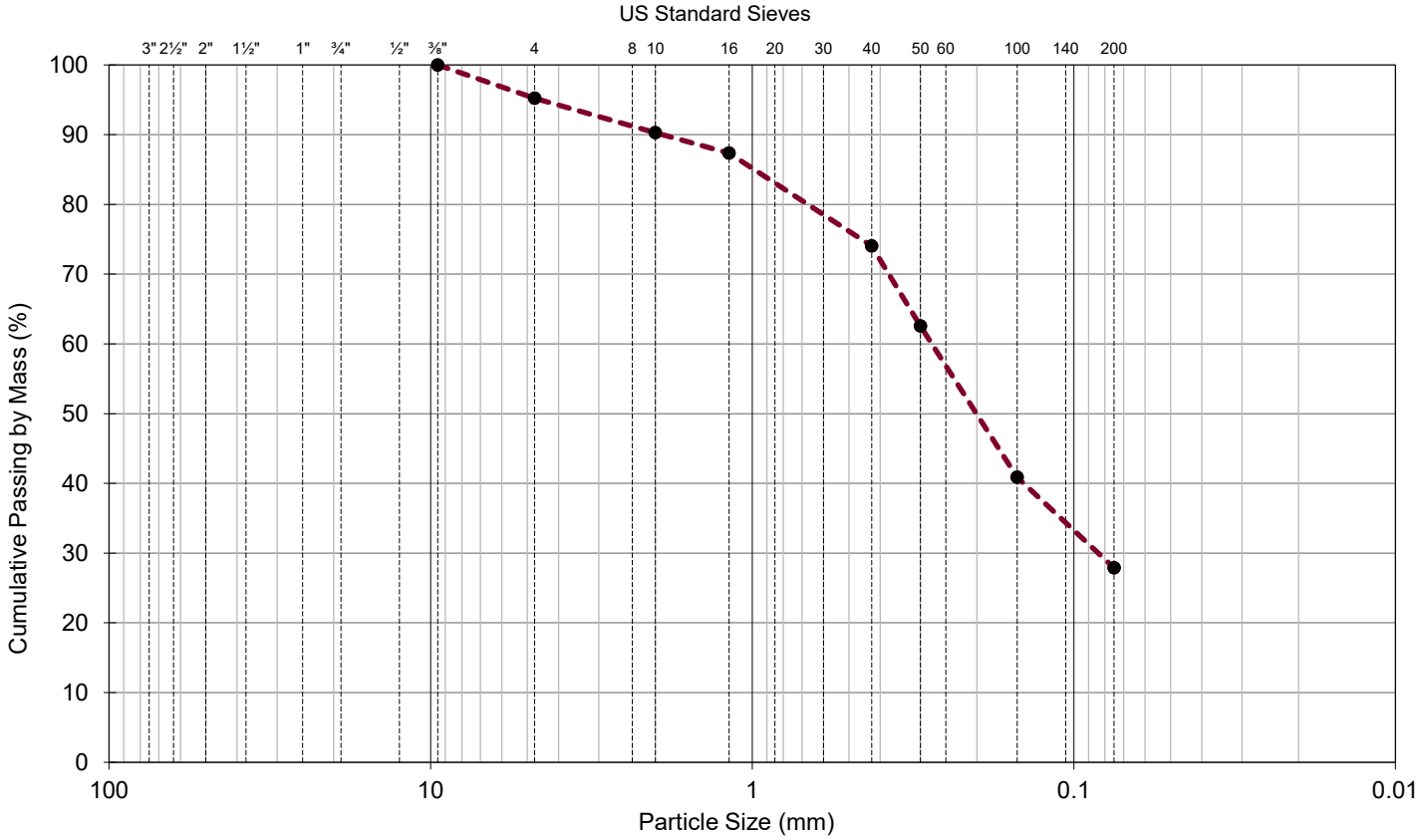
Results apply only to the specific items and locations referenced and at the time of testing. This report should not be reproduced, except in full, without the written permission of GROUND Engineering Consultants, Inc.

GROUND ENGINEERING

Project No.: 22-3677B

Bergen Valley Elementary School
Sugarbush Drive Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	95	D90	1.901
5 in	125	-	No. 8	2.36	-	D85	0.984
4 in	100	-	No. 10	2.00	90	D80	0.671
3 in	75	-	No. 16	1.18	87	D60	0.276
2.5 in	63	-	No. 20	0.85	-	D50	0.201
2 in	50	-	No. 30	0.60	-	D40	0.143
1.5 in	37.5	-	No. 40	0.425	74	D30	0.084
1 in	25.0	-	No. 50	0.300	63	D15	-
3/4 in	19.0	-	No. 60	0.250	-	D10	-
1/2 in	12.5	-	No. 100	0.150	41	D05	-
3/8 in	9.5	100	No. 140	0.106	-	Cu	-
No. 4	4.75	95	No. 200	0.075	27.9	Cc	-

Location: P-2 at 9 feet
Description: Clayey SAND

Classification: SC / A-2-6 (0)
Liquid Limit: 32
Plasticity Index: 13

Gravel (%): 5
Sand (%): 67
Silt/Clay (%): 28

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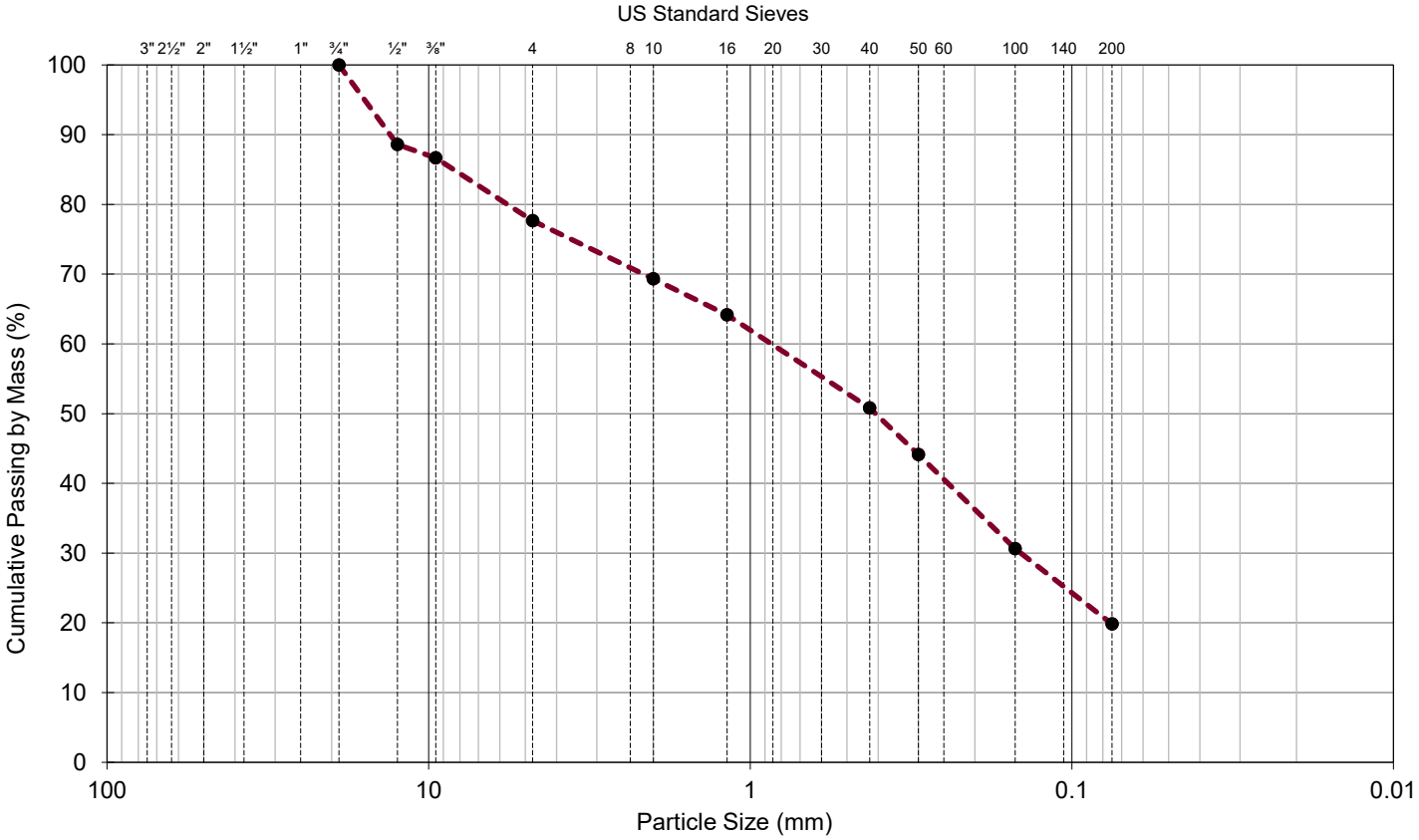
GROUND ENGINEERING

Project No.: 22-3677B

Bergen Valley Elementary School
Sugarbush Drive Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	78	D90	13.172
5 in	125	-	No. 8	2.36	-	D85	8.347
4 in	100	-	No. 10	2.00	69	D80	5.693
3 in	75	-	No. 16	1.18	64	D60	0.858
2.5 in	63	-	No. 20	0.85	-	D50	0.407
2 in	50	-	No. 30	0.60	-	D40	0.243
1.5 in	37.5	-	No. 40	0.425	51	D30	0.144
1 in	25.0	-	No. 50	0.300	44	D15	-
3/4 in	19.0	100	No. 60	0.250	-	D10	-
1/2 in	12.5	89	No. 100	0.150	31	D05	-
3/8 in	9.5	87	No. 140	0.106	-	Cu	-
No. 4	4.75	78	No. 200	0.075	19.8	Cc	-

Location: P-3 at 1 feet
Description: FILL: Silty, Clayey SAND with Gravel

Classification: (SC-SM)g / A-2-4 (0)
Liquid Limit: 24
Plasticity Index: 5

Gravel (%): 22
Sand (%): 58
Silt/Clay (%): 20

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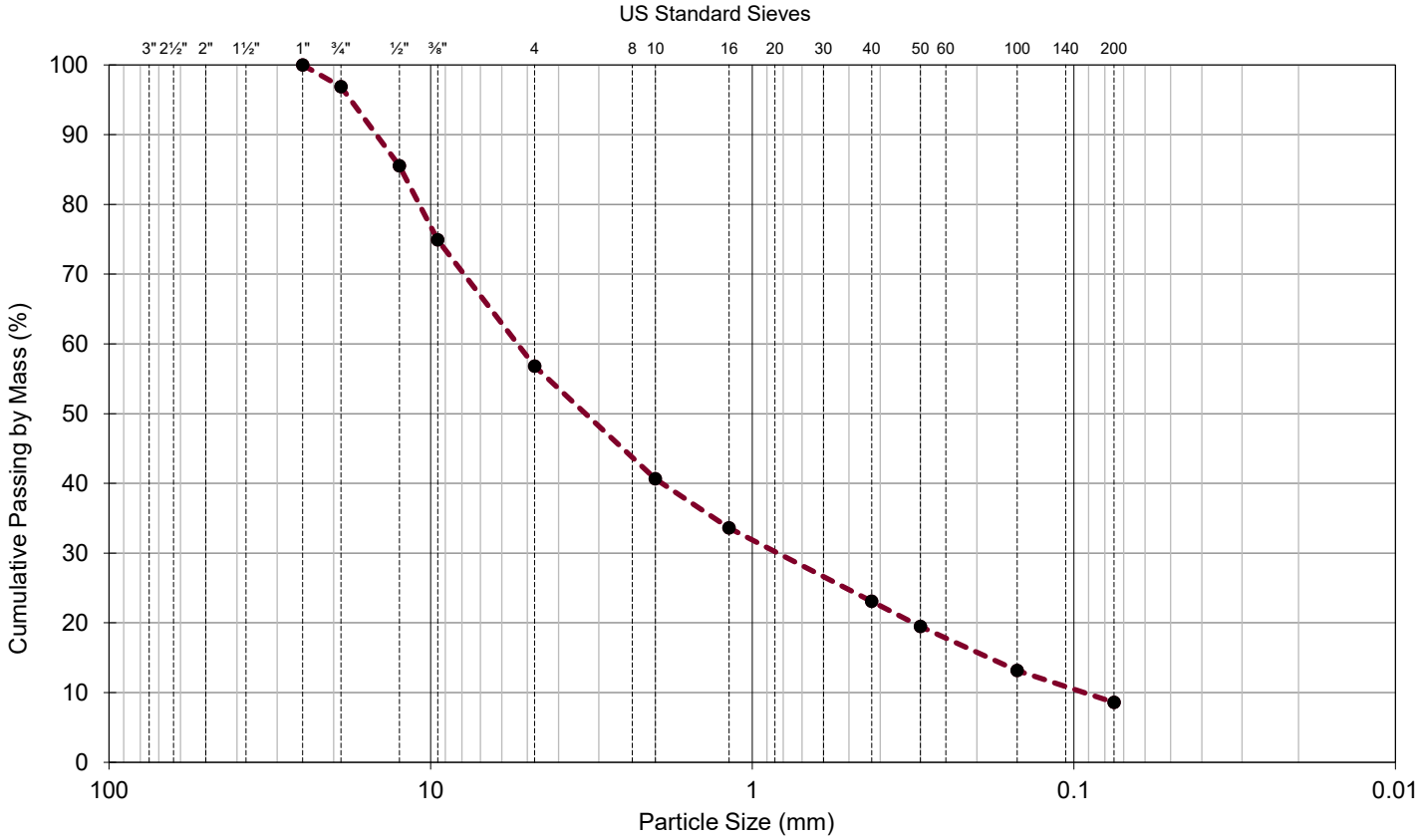
GROUND ENGINEERING

Project No.: 22-3677B

Bergen Valley Elementary School
Sugarbush Drive Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	57	D90	14.735
5 in	125	-	No. 8	2.36	-	D85	12.327
4 in	100	-	No. 10	2.00	41	D80	10.833
3 in	75	-	No. 16	1.18	34	D60	5.368
2.5 in	63	-	No. 20	0.85	-	D50	3.300
2 in	50	-	No. 30	0.60	-	D40	1.906
1.5 in	37.5	-	No. 40	0.425	23	D30	0.830
1 in	25.0	100	No. 50	0.300	19	D15	0.184
3/4 in	19.0	97	No. 60	0.250	-	D10	0.093
1/2 in	12.5	86	No. 100	0.150	13	D05	-
3/8 in	9.5	75	No. 140	0.106	-	Cu	57.768
No. 4	4.75	57	No. 200	0.075	8.6	Cc	1.382

Location: P-4 at 1.5 feet
Description: FILL: SAND with Silt and Gravel

Classification: (SP-SM)g / A-1-a (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 43
Sand (%): 48
Silt/Clay (%): 9

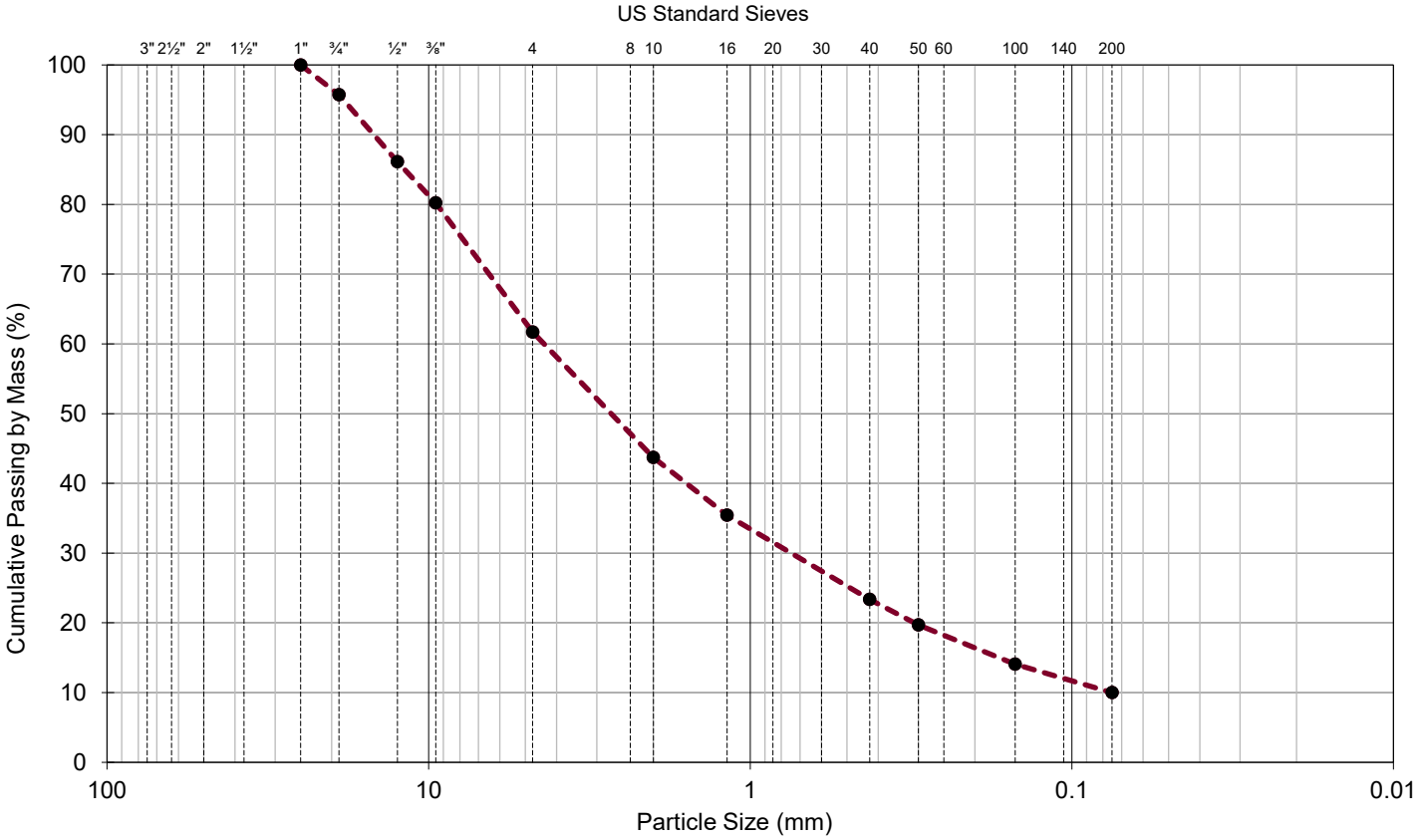
Results apply only to the specific items and locations referenced and at the time of testing. This report should not be reproduced, except in full, without the written permission of GROUND Engineering Consultants, Inc.

GROUND ENGINEERING

Project No.: 22-3677B

Bergen Valley Elementary School
Sugarbush Drive Improvements

Gradation (ASTM D422-63[2007])



Coarse Gradation			Fine Gradation			Grading	
US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	US Standard Sieve	Particle Size (mm)	Passing by Mass (%)	Coefficient	Value
6 in	150	-	No. 4	4.75	62	D90	14.810
5 in	125	-	No. 8	2.36	-	D85	11.874
4 in	100	-	No. 10	2.00	44	D80	9.429
3 in	75	-	No. 16	1.18	35	D60	4.374
2.5 in	63	-	No. 20	0.85	-	D50	2.706
2 in	50	-	No. 30	0.60	-	D40	1.579
1.5 in	37.5	-	No. 40	0.425	23	D30	0.744
1 in	25.0	100	No. 50	0.300	20	D15	0.168
3/4 in	19.0	96	No. 60	0.250	-	D10	0.075
1/2 in	12.5	86	No. 100	0.150	14	D05	-
3/8 in	9.5	80	No. 140	0.106	-	Cu	58.292
No. 4	4.75	62	No. 200	0.075	10.0	Cc	1.688

Location: P-4 at 4 feet
Description: SAND with Silt and Gravel

Classification: (SP-SM)g / A-1-a (0)
Liquid Limit: NV
Plasticity Index: NP

Gravel (%): 38
Sand (%): 52
Silt/Clay (%): 10

Results apply only to the specific items and locations referenced and at the time of testing. This report should not be reproduced, except in full, without the written permission of GROUND Engineering Consultants, Inc.

GROUND ENGINEERING

Bergen Valley Elementary School - Sugarbush Drive Improvements

Soil/Aggregate Laboratory Summary

Specification Title: Soils lab

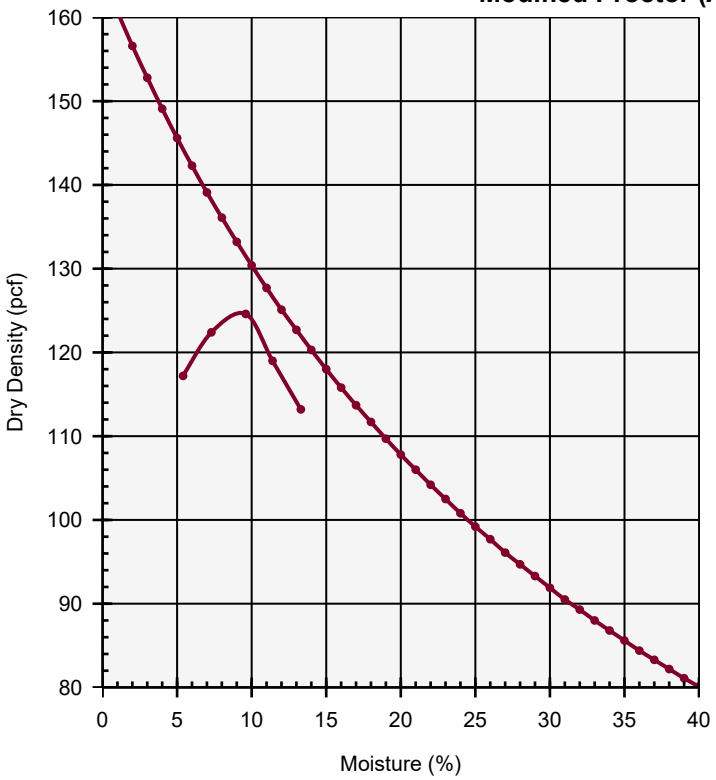
Sampling Method: ASTM D75 / AASHTO T2 / CDOT CP30

Sample Location: P-1 - P-4 from 0 - 5 feet

Atterberg Limits (ASTM D4318) and Classification (ASTM D2487 & AASHTO M145)

Method	Liquid Limit		Plastic Limit		Plasticity Index		Classification	
	Value	Spec.	Value	Spec.	Value	Spec.	USCS	AASHTO
Single Point	27	-	20	-	7	-	SC-SM	A-2-4 (0)

Modified Proctor (ASTM D1557)



Method	Preparation	Hammer
Method A	Moist Preparation	Manual

Maximum Dry Density (pcf)	Optimum Moisture (%)	Oversize Corrected	
		Maximum Dry Density (pcf)	Optimum Moisture (%)
124.6	**9.6**	128.4	8.5

Oversize Sieve: No. 4

Coarse Fraction (%): 13

Fine Fraction (%): 87

Coarse Specific Gravity: Measured 2.60

Coarse Absorption (%): 1.39

Fine Specific Gravity: Estimated 2.65

Test Remarks:

No. 200 Wash (ASTM D1140)

Method Used	Soaking Time	Initial Dry Mass (g)	Passing No. 4 (%)	Passing No. 200 (%)
Method A - Water	8	277.7	-	27.3

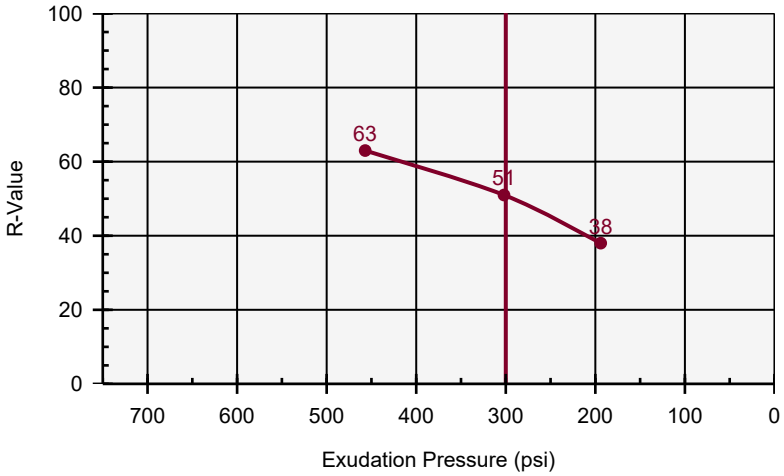
Results apply only to the specific items and locations referenced and at the time of testing, observations or special inspections. Unless noted otherwise, samples were received in adequate condition. This report should not be reproduced, except in full, without the written permission of GROUND Engineering Consultants, Inc.

GROUND ENGINEERING

Bergen Valley Elementary School - Sugarbush Drive Improvements

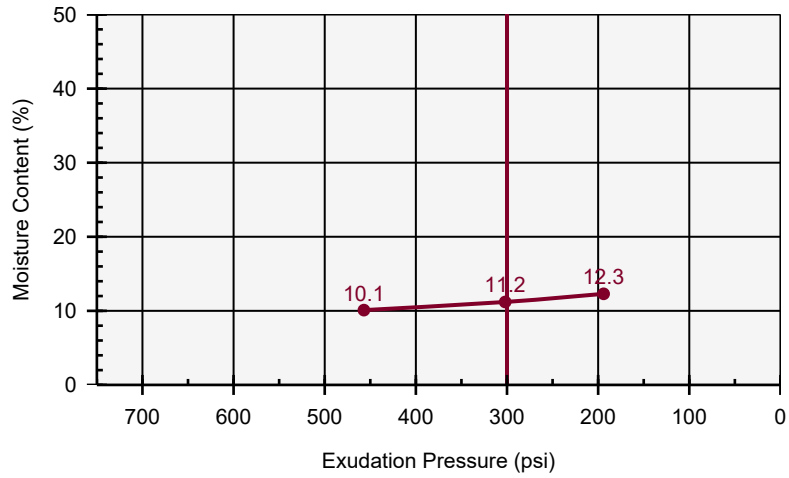
Soil/Aggregate Laboratory Summary

R-Value (CDOT CP-L 3101 / AASHTO T-190)



Test Point	Moisture (%)	Exudation Pressure (psi)	R-Value
1	12.3	194	38
2	11.2	302	51
3	10.1	457	63

R- Value at 300 psi Exudation Pressure
51



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GROUND
ENGINEERING

October 4, 2023

Subject: Limited Geotechnical Evaluation, **Bergen Valley Elementary School – Emergency Fire Access Alignments**, Evergreen, Colorado.

Job Number 23-3647

Mr. Ted Hagan
Jeffco Public Schools
809 Quail Street, Building 4
Lakewood, Colorado 80215

Dear Mr. Hagan:

This letter presents the results of a limited geotechnical evaluation performed by GROUND Engineering Consultants, Inc. (GROUND) of existing exterior concrete flatwork and pavement section thicknesses with regard to their planned use as emergency fire access alignments at the Bergen Valley Elementary School facility located at 1422 Sugarbush Drive in Evergreen, Colorado. Our study was conducted in general accordance with GROUND's Proposal No. 2309-1831, dated September 12, 2023, and Jefferson County School District's purchase order no. IPO0003048, dated August 30, 2023.

A limited subsurface exploration program was conducted to obtain information on the existing concrete flatwork and asphalt playcourt pavement section thicknesses at locations requested by Jeffco Public Schools. The results of the subsurface exploration are presented herein.

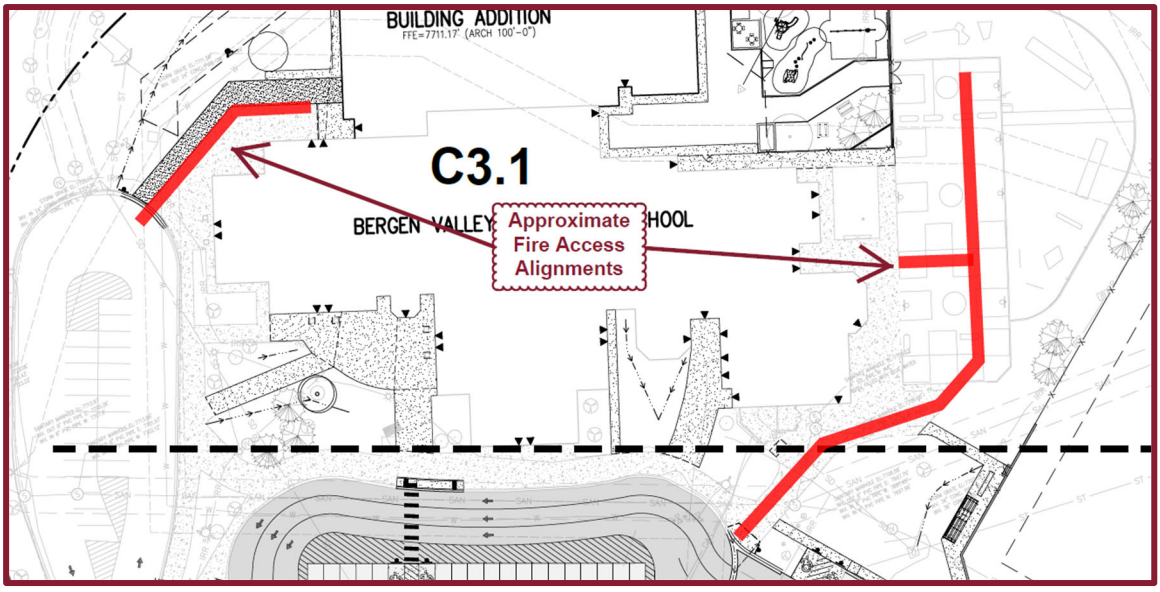
This letter has been prepared to summarize the data obtained and to provide commentary regarding the use of existing flatwork and playcourt pavements as emergency fire truck alignments. This letter should be understood and utilized in its entirety; specific sections of the text, figures, tables, and other information contained within this letter are intended to be understood in the context of the entire letter. This includes the *Closure* section of the letter which outlines important limitations on the information contained herein.

This letter was prepared for Jeffco Public Schools based on our understanding of the proposed project at the time of preparation of this letter. The data and geotechnical considerations provided herein should not be construed to be sufficient for other purposes, including the use by contractors, or any other parties for any reason not specifically related to the design of the project. Furthermore, the information provided in this letter was based on the exploration methods described below. Deviations between what was reported herein and the actual surface and/or subsurface conditions may exist, and in some cases those deviations may be significant.

GROUND Engineering Consultants, Inc. (GROUND) previously performed a geotechnical evaluation and report in support of design and construction of the proposed additions, facility access improvements, and associated site improvements at the Bergen Valley Elementary School facility under GROUND Job No. 22-3677A (dated June 2, 2023). Geotechnical considerations and parameters for the construction of new pavements at the facility were provided in that report. Additionally, descriptions of the subgrade conditions provided herein were extrapolated from data available in that report.

Proposed Construction

Based on a provided site plan (see excerpt below) and correspondence with the client, we understand portions of the existing exterior concrete flatwork and asphalt playcourt pavements along the northwestern, eastern, and southeastern margins of the school building are planned to serve as emergency fire access alignments.



The project site is shown above and in Figure 1. If proposed construction, including the anticipated site grading, traffic loading, and proposed improvement locations, differs from those described above, or changes subsequently, GROUND should be notified to re-evaluate the information in this letter.

Site Conditions

Looking southeast toward the northwestern access alignment.

Looking northeast toward the eastern access alignment

At the time of our exploration, the project site consisted of the Bergen Valley Elementary School facility. The facility was situated on a bench within a valley located between Sugarbush Drive to the south and Evergreen Parkwa to the north. Undeveloped, semi-forested land and residential developments bordered the site to the east and west. The existing school building consisted of a single-story building with a masonry exterior. Concrete flatwork wrapped the perimeter of the building and an asphalt entry drive, drive lanes, and parking areas were located south and west of the building. An asphalt playcourt and pea-gravel playground area were located east of the building. Basketball hoops and bicycle racks were noted within the playcourt and flatwork areas east of the building.

The subject alignment area northwest of the building consisted generally of jointed concrete flatwork. Cracking was noted locally within the concrete near the existing asphalt-paved drive loop. Additionally, portions of the existing concrete flatwork appeared

younger than the majority of the flatwork. This suggests more extensive distress to the concrete flatwork occurred historically and led to their localized removal and replacement.

The subject alignment area east of the building consisted generally of jointed exterior concrete flatwork within the southern portion and asphalt playcourt pavement within the northern portion. Cracking was noted locally within the concrete. Block cracking and raveling were noted within the asphalt playcourt.

Subsurface Exploration

GROUND cored the existing exterior concrete flatwork and asphalt playcourt pavement at five (5) locations requested by Jeffco Public Schools. The approximate locations of the cores, the flatwork/pavement material type, and approximate thicknesses are presented in Figure 1. This information is also summarized in the table below.

General Site Area	Core Location	Flatwork/Pavement Material Type	Approximate Thickness *(inches)*
Eastern Fire Access Alignment	C-1	Asphalt	5
	C-2	Asphalt	4¼
	C-3	Asphalt	5
	C-4	Concrete	8¾
Northwestern Fire Access Alignment	C-5	Concrete	5

Based on extrapolation from the subsurface conditions encountered in the test holes drilled during our previous geotechnical evaluation (see GROUND Job No. 22-3677A), we assume similar subgrade materials underly the existing flatwork/pavements. These materials generally consisted of silty to clayey sands and gravels.

Emergency Fire Access Alignments

We understand the fire department (assumed to be the Evergreen Fire Protection District) seeks confirmation that the designated emergency fire access alignments at the facility

are of sufficient thickness to support their trucks. Our experience indicates emergency fire access alignments may be required by local authorities to provide support for emergency access by fire trucks/emergency vehicles weighing up to 90,000 pounds.

The AASHTO pavement design approach calculates the pavement section thickness required to withstand cyclically applied loads over the pavement lifespan based on the strength of the pavement subgrade soils and other factors. The applied loads, referred to as 18-kip equivalent single-axle loads (ESALs), express the equivalent damage from different types of vehicles as compared to an 18,000-pound axle load. For example, passenger automobiles typically have a load equivalency factor (LEF) of 0.003 (meaning it would take around 333 trips to equal 1 ESAL). Emergency vehicles (including fully loaded fire trucks) commonly have LEF's ranging from 0.21 to 7. To determine the design traffic loading, the amount of daily vehicle trips is multiplied by associated LEF which is then scaled up to the design life (typically 20 years).

We assume emergency vehicles will only utilize the fire access alignments very occasionally during emergency situations and that they will not be subjected to any significant additional traffic. For this analysis, we assumed 1 fire truck will utilize each temporary fire access alignment each month for a design life of 20 years. We also assumed a LEF of 7. This corresponds to approximately 1,680 ESALs over a 20-year design life.

Jeffco Public Schools and the fire department should review the traffic loading based on the knowledge and understanding of the emergency fire access alignments and their current/potential use characteristics. If design traffic loadings differ significantly from the assumed/developed values, the considerations provided below should be re-evaluated.

Based on the assumed traffic loading, the thickness of the existing flatwork/asphalt, and the assumed subgrade materials, the existing concrete flatwork and asphalt playcourt pavements appear to be capable of supporting a fire truck. However, It should be noted that the pavement section is not anticipated to support fire truck outriggers without cribbing or similar measures.

We also anticipate that distress is likely to occur when the existing flatwork/pavements are subjected to loading from fully loaded emergency vehicles including fire trucks. The playcourt asphalt is likely to be rutted, depressed, pushed, and otherwise damaged by the

weight of the emergency vehicle. Similarly, concrete cracking should be anticipated. Jeffco Public Schools should anticipate associated maintenance costs that will be necessary to re-establish effective drainage, replace destressed flatwork/pavement, etc.

Geotechnical considerations and parameters for new pavements (including heavy truck traffic areas and fire lanes) were provided in our report for the project (GROUND Job No. 22-3677A, report dated June 2, 2023).

Closure

This letter has been prepared for Jeffco Public Schools as it pertains to the proposed emergency fire access alignments at Bergen Valley Elementary School facility in Evergreen, Colorado as described herein. It should not be assumed to contain sufficient information for other parties or other purposes. The Client has agreed to the terms, conditions, and liability limitations outlined in our proposal. Reliance upon our letter is not granted to any other potential owner, contractor, or lender.

In addition, GROUND has assumed that project construction will commence by spring 2024 and will finish within a year of the project commencement date. Any changes in project plans or schedule should be brought to the attention of a geotechnical engineer, in order that the geotechnical conclusions in this letter may be re-evaluated and, as necessary, modified.

The geotechnical conclusions in this letter were based on subsurface information from a limited number of exploration points, as shown in *Figure 1*, as well as the means and methods described herein. Subsurface conditions were extrapolated beyond this location. It is not possible to guarantee the subsurface conditions are as indicated in this letter. Actual conditions exposed during construction may differ from those encountered during site exploration. Design modifications may be necessary by the project team; this may result in an increase in project costs and schedule delays. In addition, a contractor who obtains information from this letter for development of his scope of work or cost estimates does so solely at his own risk and may find the geotechnical information in this letter to be inadequate for his purposes or find the geotechnical conditions described herein to be at variance with his experience in the greater project area. The contractor should obtain the additional geotechnical information that is necessary to develop his workscope and cost estimates with sufficient precision. This includes, but is not limited to, information

regarding excavation conditions, earth material usage, current depths to groundwater, etc. Because of the necessarily limited nature of the subsurface exploration performed for this study, the contractor should be allowed to evaluate the site using test pits or other means to obtain additional subsurface information to prepare his bid.

If during construction, surface, soil, bedrock, or groundwater conditions appear to be at variance with those described herein, work should cease and a geotechnical engineer should be retained at once, so that our conclusions and design parameters for this site may be re-evaluated in a timely manner and dependent aspects of project design can be modified, as necessary.

The materials present on-site are stable at their natural moisture content, but may change volume or lose bearing capacity or stability with changes in moisture content. Performance of the proposed improvements will depend on implementation of the conclusions and information in this letter and on proper maintenance after construction is completed. Because water is a significant cause of volume change in soils and rock, allowing moisture infiltration may result in movements and should therefore be expected by Jeffco Public Schools.

ALL DEVELOPMENT CONTAINS INHERENT RISKS. It is important that ALL aspects of this letter, as well as the estimated performance, as applicable, (and limitations with any such estimations) of proposed improvements are understood by Jeffco Public Schools. Utilizing the geotechnical parameters and measures herein for planning, design, and/or construction constitutes understanding and acceptance of the conclusions with regard to risk and other information provided herein, associated improvement performance, as well as the limitations inherent within such estimates. Ensuring correct interpretation of the contents of this letter by others is not the responsibility of GROUND. If any information referred to herein is not well understood, it is imperative that Jeffco Public Schools contact the author or a GROUND principal immediately. We will be available to meet to discuss the risks as presented in this letter, as well as other potential approaches, upon request.

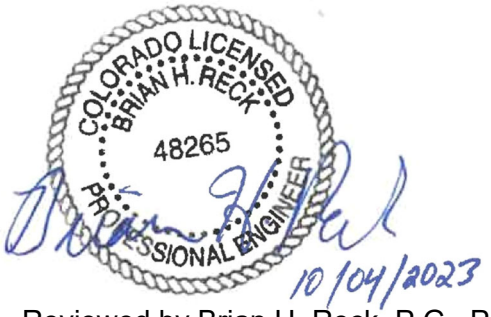
Current applicable codes may contain criteria regarding performance of structures and/or site improvements which may differ from those provided herein. Our office should be contacted regarding any apparent disparity.

GROUND makes no warranties, either expressed or implied, as to the professional data, opinions or conclusions contained herein. Because of numerous considerations that are beyond GROUND's control, the economic or technical performance of the project cannot be guaranteed in any respect**.**

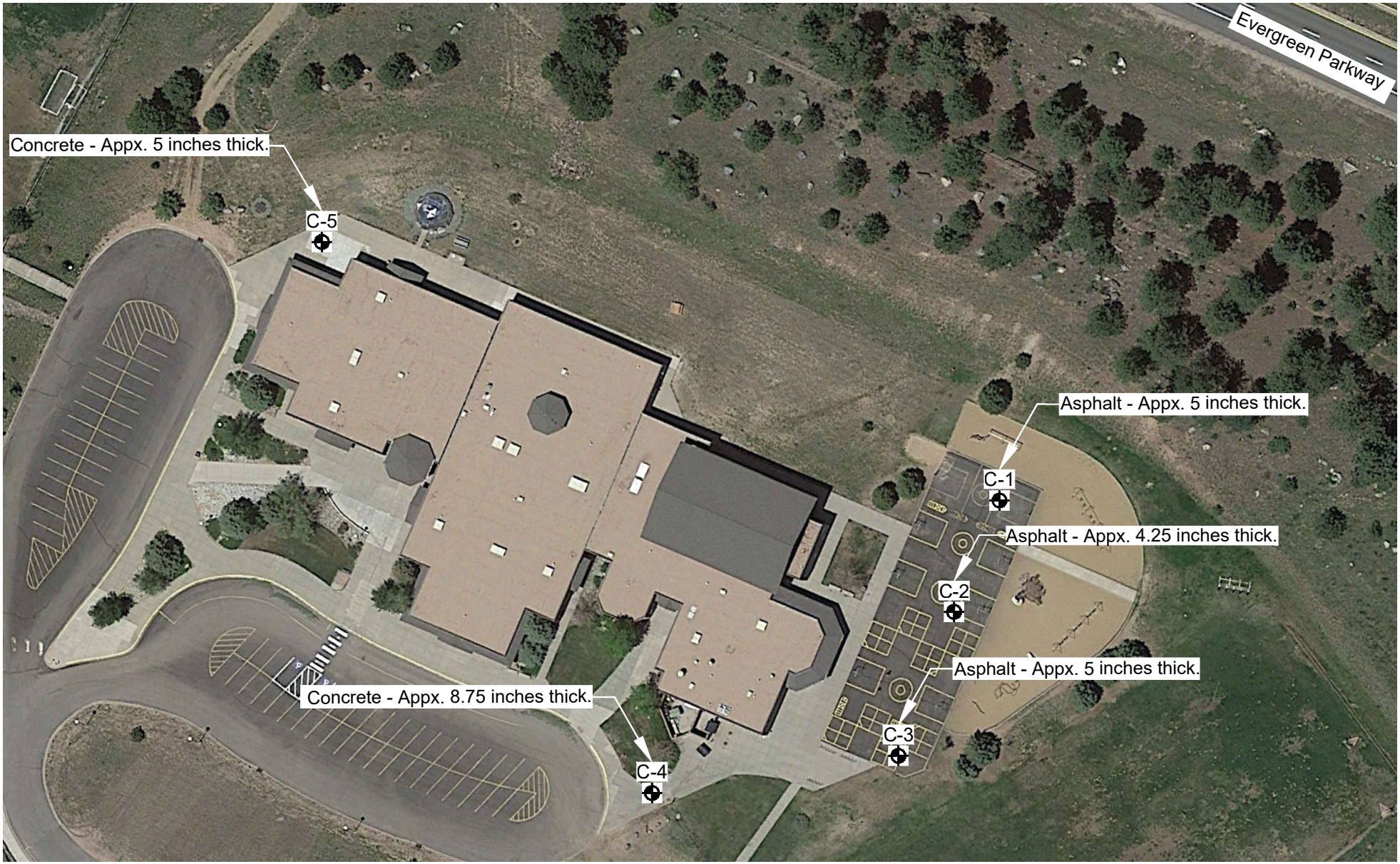
This document, together with the concepts and conclusions presented herein, as an instrument of service, is intended only for the specific purpose and client for which it was prepared. Re-use of, or improper reliance on this document without written authorization and adaption by GROUND Engineering Consultants, Inc., shall be without liability to GROUND Engineering Consultants, Inc.

Sincerely,
GROUND Engineering Consultants, Inc.

Brian J. Knecht, P.G.



Reviewed by Brian H. Reck, P.G., P.E.



GOOGLE EARTH AERIAL IMAGE (6/10/2021)

C-5
Indicates core numbers and approximate locations.

NOT TO SCALE

GROUND ENGINEERING

JOB NO.: 23-3647

FIGURE: 1

CORING LOCATIONS

BID FORM FOR STIPULATED SUM (SINGLE PRIME CONTRACT)

TO: Board of Education
Jefferson County School District R-1
c/o Facilities Planning and Design/Construction Management
809 Quail Street, Building #4
Lakewood, Colorado 80215

FROM: _____

PROJECT IDENTIFCATION: **Bergen Valley Elementary School Addition**

ACKNOWLEDGEMENTS:
The undersigned Bidder acknowledges examination of the following:

a) Contract Documents
   - Drawings dated 07/31/2023
   - Project Manual dated 07/31/2023
   - Other

b) Project Site/Existing Conditions
c) Receipt of Addenda Number: _____

AGREEMENTS: The undersigned Bidder agrees to the following:

a) To hold bid open for 45 calendar days from date of Bid Opening.
b) To accept provisions of the Instructions to Bidders regarding disposition of the Bid Security.
c) To enter into and execute the Construction Agreement within ten (10) calendar days of award, if awarded on the basis of this bid, including identified Bonds and Insurance.
d) To accomplish the work in compliance with the Contract Documents.
e) To pay the Jefferson County School District No. R-1 liquidated damages according to the terms, amount(s) and date(s) defined in the Supplementary General Conditions.
f) Jefferson County School District No. R-1 reserves the right to reject any or all bids and to waive informalities.
g) Jefferson County School District No. R-1 reserves the right to award separate or single contracts.
h) Jefferson County School District No. R-1 reserves the right to award the contract on the basis of either cost or schedule.

BID: _____

ALTERNATE 1: _____

~~ALTERNATE 2:~~ **NOT USED** _____

ALTERNATE 3: _____

SCHEDULE:

The Contractor may begin mobilization on **October 23, 2023**. The work must be completed by **August 2, 2024**.

ATTACHMENTS:

a) Bid Security
b) List of Subcontractors (required within 24 hours of bid opening)

Dated this _____ day of _____ , _____

SIGNATURES:

The Bidder: _____

_____
Address

_____
County of Incorporation

_____
Phone:

By:

_____ _____
Print Name/Title Signature

If the Bid is being submitted by a Corporation, the Bid Form should be signed by an officer (i.e., President or Vice President). The signature of the office signing shall be attested to by the Secretary and properly sealed. If the Bid is being submitted by an individual or a partnership, the Bid Form shall so indicate and be properly signed.

END OF SECTION

JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
LAKEWOOD, COLORADO

GENERAL CONDITIONS OF THE CONTRACT

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1.0 CONTRACT DOCUMENTS

The work shall be accomplished in accordance with the Contract Documents which shall consist of the Invitation to Bid, Instructions to Bidders, Bid Security, Proposal, Notice of Contract Award, Insurance Policies and Certificates, Notice to Proceed, Performance Bond, Labor and Material Payment Bond, Agreement for Construction Services, which includes the Summary of Contract Terms, hereinafter referred to as the Agreement, the General Conditions of the Contract, Supplementary General Conditions, drawings and specifications, tests and engineering data, approved change orders, Contractor's Requests for Payment, Architect's Certificates, and all addenda issued by the Owner or Architect prior to the execution of the Agreement and all modifications issued by the Owner or Architect after the execution of the Agreement.

2.0 DEFINITIONS

Words, phrases, and other expressions used in these Contract Documents shall have meanings as follows:

2.1 "Contract" or "Contract Documents" shall include the items enumerated in GC-1.00 above.

2.2 "Owner" shall mean the Jefferson County School District No.R-1 acting through its duly authorized representatives.

2.3 "Contractor" shall mean the corporation, company, partnership, firm, entity, or individual named and designated as such in the Contract Documents which has entered directly into this Contract with the Owner for the performance of the work covered thereby, and any persons or entities acting on its behalf.

2.4 "Subcontractor" shall mean and refer to a corporation, partnership, entity, or individual having a direct contract with the Contractor or another subcontractor for performing work and/or furnishing labor or material on the project covered by the Contract.

2.5 "Architect" shall mean the architects or engineers designated, appointed, or otherwise employed or delegated by the Owner, or its duly authorized representatives, acting within the scope of the particular duties entrusted to them in each case.

2.6 "Notice to Contractor" shall be deemed to have been duly served if made in writing and delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended, if sent by registered or certified mail to the last known business address, or if sent electronically with verification of delivery and read receipt.

2.7 "The work" shall mean the construction and services required by the Contract Documents for completion of the project, and includes labor, materials, equipment and services provided by the Contractor to fulfill the Contractor’s obligations, whether on or off the project site, and all labor, materials, equipment and services provided or to be provided by subcontractors, sub-subcontractors, or any other entity for whom the Contractor is responsible.

2.8 "The project" is the total construction designed by the Architect of which the work performed under the Contract Documents may be the whole or a part.

2.9 The "date of completion" and "finally completed" shall mean the date when construction is certified by the Architect to be finally completed in accordance with

Contract Documents, as modified by any change orders agreed to by the parties and when the Owner has fully accepted the project for the use for which it was intended. Such date will be set forth on a Letter of Acceptance issued by the Owner.

2.10 "Drawings" or "plans" shall mean all (a) drawings furnished by the Owner and/or Architect as a basis for the award of Contract and for construction of the project; (b) supplementary drawings furnished by the Owner and/or Architect to clarify and to define in greater detail the intent of the Contract drawings and specifications; (c) drawings submitted by the successful Contractor as may be required after the Contract is awarded; (d) drawings furnished by the Owner and/or Architect to the Contractor during the progress of the work; and (e) engineering data and drawings submitted by the Contractor during the progress of the work, provided such drawings are acceptable to the Architect.

2.11 "Specifications" are the written technical information concerning materials, components, systems, equipment, and manner of installation as indicated on the drawings or plans and which state the quality, performance, characteristics, and installations to be achieved by application of construction methods.

2.12 "change order" shall mean a written order to the Contractor signed by the Owner of its authorized agent issued after the execution of the Agreement, authorizing (a) a change in the work, and/or (b) adjustment in the Contract Sum Total and/or Unit Price, and/or (c) a change in the contract time schedule.

2.13 "day" or "days" shall mean calendar days. In computing a period of days, when the ending date is not specified, the first day is excluded and the last day is included. If any deadline falls on a Saturday, Sunday, or federal or Colorado state holiday, such deadline will be extended to the next day that is not a Saturday, Sunday, or federal or Colorado state holiday.

3.0 ORAL STATEMENTS

It is understood and agreed that the written terms and provisions of the Contract Documents shall supersede all oral statements of representatives of the Owner, Architect, Contractor and their representatives, and that oral statements shall not be effective or be construed as being a part of this Contract.

4.0 REFERENCE STANDARDS

Reference to the standards of any technical society, organization, or association, or to codes of local or state authorities, shall mean the latest standard, code, specification, or tentative standard adopted and published at the date of the Contract Documents unless specifically stated otherwise.

5.0 ITEMS COVERED BY CONTRACT PRICE

Unless specifically stated otherwise, the Contractor shall accept the compensation stated in the Agreement as full payment for furnishing all the materials, transportation, apparatus, temporary structures, equipment, services, fuel, energy, light, water, labor and tools, and all other things necessary for the complete and proper execution of the work contemplated by or reasonably implied from the Contract Documents, within the time limits indicated therein. Such amount shall include any loss or damage resulting from the nature of the work, from the elements or from any unforeseen difficulties that may be encountered; all risks of every description connected with the prosecution of the work; all expenses incurred in consequence of any suspension or discontinuance of the work; and

all other amounts necessary for completing the work pursuant to the Contract Documents within the time limits indicated therein.

6.0 EXECUTION, CORRELATION, INTENT, AND INTERPRETATION OF CONTRACT DOCUMENTS

6.1 Execution. The Contract Documents shall be signed in multiple copies as directed by the Owner. Within ten (10) days of Notice of Contract Award, the Contractor shall submit to the Owner a minimum of two (2) fully executed original sets of the Construction Agreement; Performance Bond and Labor and Material Payment Bond with original Power of Attorney; and certificates of required insurance coverage. The date of the Contract for purposes of these documents shall be the date of the Notice of Contract Award letter. The Owner will execute the Agreement, assemble all copies, and distribute the Contract Documents. The Contractor shall not commence the work until it receives the Notice to Proceed.

6.2 Correlation. By executing the Agreement, the Contractor represents that it has visited the site, familiarized itself with the local conditions under which the work is to be performed, and correlated its observations with the requirements of the Contract Documents.

6.3 Intent. The intention of the Contract Documents is to include all labor and materials, tools, equipment, construction equipment, water, heat, utilities, transportation, and other facilities and services necessary for the proper execution and completion of the work. Materials or work described in words, which as applied, have a well-known technical or trade meaning shall be held to refer to such recognized meaning.

6.3.1 The organization of the specifications into divisions, sections, and articles, as the case may be, and the arrangement of drawings shall not control the Contractor in dividing the work among subcontractors or in establishing the extent of work to be performed by any trade.

6.3.2 It is intended that even though work is not covered under any heading, division, section, article, branch, class, or trade of the specifications, it shall nevertheless be supplied if it is required elsewhere in the Contract Documents or is reasonably inferable therefrom as being necessary to produce the intended results.

6.3.3 The specifications and drawings are intended to supplement but not necessarily duplicate each other. Any work exhibited in the one and not in the other shall be executed as if it had been set forth in both, so that the work will be constructed according to the complete design as determined by the Architect.

6.4 Interpretation. Should anything necessary for a clear understanding of the work be omitted from the specifications and drawings, or should the requirements appear to be in conflict, the Contractor shall secure written interpretations or instructions from the Architect before proceeding with the work affected thereby. It is understood and agreed that the work shall be performed according to the intent of the Contract Documents.

6.5 Conflict in Interpretation. Where a conflict occurs between or within standards, specifications, and drawings, the more stringent or higher quality requirements shall apply. In the case of a discrepancy or in the event of a conflict between the different Contract Documents, the documents shall take precedence in the following order:

6.5.1 Executed change orders;

6.5.2 Agreement;

6.5.3 Supplementary General Conditions;

6.5.4 General Conditions;

6.5.5 Bid addenda;

6.5.6 Bid documents..

Where two or more of the Contract Documents are complementary, the more detailed provision shall control over the more general provision..

7.0 DRAWINGS AND SPECIFICATIONS

7.1 Copies Furnished. Unless otherwise provided in the Contract Documents, the Contractor will be furnished, free of charge, all copies of drawings and specifications reasonably necessary for the execution of the work.

7.2 Ownership of Drawings. All drawings, specifications, and copies thereof furnished by the Architect are the property of the Architect and the Owner, whether the work for which they are made be executed or not, and are not to be used on other work except by written agreement with the Architect and the Owner.

7.3 Drawings and Specifications Available on the Site. The Contractor shall maintain at the site for the Owner and the Architect one copy of all drawings, specifications, addenda, approved shop drawings, change orders, and other modifications, in good order and marked to record all changes made during construction. The Contractor shall also keep on the site all applicable standards, codes, manufacturer's or other specifications referenced in the Contract Documents. The drawings, marked to record all changes made during construction, shall be delivered to the Architect for the Owner upon completion of the work.

7.4 Figured Dimensions to Govern. Dimensions and elevations shown on the drawings shall be accurately followed. No work shown on the drawings, the dimensions of which are not indicated, shall be executed until necessary dimensions have been obtained from the Architect.

7.5 Contractor to Check Drawings and Schedules. The Contractor shall check all dimensions, elevations, and quantities shown on the drawings furnished to them by the Architect, and shall notify the Architect of any discrepancy between the drawings and the conditions on the ground, or any error or omission in drawings, or in the layout as given by stakes, points, or instructions, which they may discover. Before ordering any material or doing any work, the Contractor shall verify all measurements at the building and shall be responsible for the correctness of same. Any difference, which may be found between an actual dimension and the measurement indicated on the drawing, shall be submitted to the Architect for consideration before proceeding with the work. The Contractor will not be allowed to take advantage of any error or omission in the drawings or Contract Documents. Full instructions will be furnished by the Architect should such error or omission be discovered, and the Contractor shall carry out such instructions as if originally specified.

7.6 Detail Drawings and Instructions. The Architect shall furnish with reasonable promptness, additional instructions by means of drawings or otherwise, necessary for the proper execution of the work. All such drawings and instructions shall be consistent with the Contract Documents, true developments thereof, and reasonably inferable therefrom. The work shall be executed in conformity therewith, and the Contractor shall do no work without proper drawings and instructions.

7.7 Project Record Drawings. The Contractor shall maintain a Contract set of drawings at the site with all changes or deviations from the original drawings neatly marked thereon in a contrasting color. The Contractor shall also maintain a Contract set of specifications at the site, noting therein by appropriate section, the names, models, and other distinguishing characteristics of the products actually incorporated into the work. This set of drawings and

specifications shall be updated daily as the job progresses and shall be made available to the Owner and Architect for inspection at all times. Upon completion of the work and before final payment, this Project Record set of drawings and specifications shall be delivered to the Architect. The accuracy of the Project Record Drawings shall be verified monthly as part of the monthly payment application process.

8.0 SHOP DRAWINGS AND SAMPLES

8.1 Shop Drawings. "Shop drawings" are drawings, diagrams, illustrations, schedules, performance charts, brochures, manufacturer's literature, and other data which are prepared by the Contractor or any subcontractor, manufacturer, supplier, or distributor, and which illustrate some portion of the work. The Owner may require the submission of shop drawing, product data and other submittals in electronic format.

8.2 Samples and Mockups. "Samples" and "Mockups" are physical examples furnished by the Contractor to illustrate materials, finishes, equipment, or workmanship, and to establish standards by which the work will be judged.

8.3 Subcontractor. The Contractor shall require each subcontractor to prepare, stamp with its approval, and submit to the Contractor with reasonable promptness and in orderly sequence so as to cause no delay in the work or in the work of any other subcontractor, all shop drawings and samples on all shop fabricated items and on all matters required by the Contract Documents or subsequently by the Architect as covered by modifications. Shop drawings and samples will properly identify specified items. At the time of submission, the subcontractor shall inform the Contractor and the Architect in writing of any deviation in the shop drawings or samples from the requirements of the Contract Documents. Substitutions will be allowed only in accordance with the provisions of GC 37 hereinafter.

8.3.1 The Contractor shall also require each subcontractor to prepare and transmit sufficient sets of prints of all shop drawings which are specially drawn for this project, including detailed fabrication and erection drawings, setting drawings, diagrammatic drawings, material schedules, and samples to the Contractor to meet the project construction schedule and the subcontractors' Contract schedule, or shall present, in writing, valid reasons for any delay.

8.3.2 All shop drawings for all equipment in a given system shall be submitted at one time, each complete set in a separate brochure. Complete maintenance and /warranty data are to be submitted to the Contractor and Architect for review and for submission to the Owner at the completion of the work, prior to Owner training being scheduled and prior to final project acceptance.

8.3.3 Each sheet of shop drawings shall identify the project, subcontractor, and fabricator or manufacturer and the date of the drawings. All shop drawings shall be numbered in sequence and each sheet shall indicate the total number of sheets in the set.

8.3.4 The shop drawings shall indicate types, gauges, and finish of all materials. Sufficient data in each set of shop drawings shall be included to permit a detailed study of the system submitted and its conformance to the Contract Documents and design intent.

8.3.5 The Contractor shall review for conformity to Contract Documents, approve, stamp, and then submit the shop drawings and samples to the Architect for approval with copies to the Owner. After review, the Architect will then return the prints to the Contractor with the Architect's appropriate comments. Those returned for

correction shall be corrected and resubmitted. Upon receiving the approved prints from the Architect, the Contractor will make requested sets of prints for distribution to appropriate subcontractors, fabricators, manufacturers, and suppliers who require them for coordination of their work.

8.4 Verification. By approving and submitting shop drawings and samples, whether prepared by the Contractor or a subcontractor, the Contractor thereby represents that it has determined and verified all field measurements, field construction criteria, dimensions, elevations, quantities, materials, catalog numbers, and similar data, as shown on the drawings and specifications furnished by the Architect and that it has checked and coordinated each shop drawing and sample with the requirements of the work and of the Contract Documents.

8.5 Architect Review. The Architect will review and approve shop drawings and samples with reasonable promptness so as to cause no delay, but only for conformance with the design concept of the project and with the information given in the Contract Documents. The Architect's approval of a separate item shall not indicate approval of an assembly in which the item functions. On the completion of the work, the Architect shall be furnished two corrected copies of all shop or setting drawings showing the as-built condition of the work. The Architect, after review, shall submit one of these copies to the Owner.

8.6 Corrections. The Contractor shall make any corrections required by the Architect and shall resubmit the required number of corrected copies of shop drawings or new samples until approved. The Contractor shall direct specific attention in writing or on resubmitted shop drawings to revisions other than the corrections requested by the Architect on previous submissions.

8.7 Contractor's Responsibility. The Architect's approval of shop drawings or samples shall not relieve the Contractor of responsibility for any deviation from the requirements of the Contract Documents unless the Contractor has informed the Architect in writing of such deviation at the time of submittal and the Architect has given written approval to the specific deviation, nor shall the Architect's approval relieve the Contractor from responsibility for errors or omissions in the shop drawings or samples.

8.8 Architect Approval Required. No portion of the work requiring the submission of a shop drawing or sample shall be commenced until such submittal has been approved by the Architect. All such portions of the work shall be in accordance with approved shop drawings and samples.

8.8.1 All material finishes and samples will be approved at one time. The Contractor shall submit all items requiring approval of finishes, color, material, etc., with sufficient lead time to allow simultaneous consideration and preparation of complete finish color schedule. No approvals of single items will be considered.

9.0 MATERIALS, LABOR, FACILITIES, AND STORAGE

9.1 Contractor's Responsibility. Unless otherwise stipulated, the Contractor shall provide and pay for all materials, labor, tools, equipment, machinery, transportation, and other facilities necessary for the proper execution and completion of the work. Unless otherwise stipulated, the Contractor shall provide and pay for all the temporary facilities required to supply all the power, light, water, and heat needed by it and the subcontractors for their work and shall install and maintain all such facilities in such manner as to protect the public and workmen and conform with any applicable laws and regulations. If temporary heat and/or protection is required for the expeditious prosecution of the work and before the permanent

heating apparatus is available for use, the temporary heating apparatus shall be installed and operated in such a manner that the finish work and/or construction will not be damaged thereby.

9.1.1 Unless otherwise specified, the Contractor shall pay for all the power, light, and water used by it and the subcontractors, without regard to whether such items are metered by temporary or permanent meters. The cutoff date on permanent meters shall be either the agreed date of full occupancy by the Owner or the date of final acceptance of the project, whichever shall be the earlier date. Upon completion of the work, the Contractor shall remove all such temporary facilities from the site.

9.2 Materials. All materials shall be new and both workmanship and materials shall be of the specified quality. The Contractor shall furnish satisfactory evidence as to the kind and quality of materials. Samples shall be furnished, when specified, and the work shall be in accordance with those samples, which have been approved.

9.3 Facilities and Storage. The Contractor shall provide and maintain, in a neat and sanitary condition, adequate temporary toilet facilities for the use of any and all employees engaged on the work, in a location approved by the Owner and in strict compliance with the requirements of all applicable codes, regulations, laws, and ordinances. In no event may toilet facilities of any existing building at the site of the work be used by employees of the Contractor or subcontractors. Upon completion of the work, all such temporary facilities shall be removed from the site.

9.3.1 The Contractor shall provide suitable temporary facilities and shall maintain on premises watertight storage shed or sheds, tool houses for storage of building materials and tools, which may be damaged by weather. The Contractor shall allow space for the erection of sheds and provide similar facilities for storage by subcontractors of their materials and tools. Storage of materials shall be confined to the site. These facilities shall further provide for protection against theft and damage of building materials and tools. Upon completion of the work, the Contractor shall remove all such temporary facilities from the site.

9.3.2 The Contractor shall provide adequate, weatherproofed, heated, and well-lighted office space at the site of the work, for the use of the Architect and the Owner and their representatives.

9.3.3 All of the foregoing facilities shall be of a quality and placed in locations acceptable to the Architect and the Owner.

10.0 EMPLOYEES, LABOR, WORKMANSHIP & SCHOOL SECURITY

10.1 Responsibility for Employees. The Contractor shall be responsible to the Owner for the acts and omissions of all its agents and employees. The Contractor shall further be responsible for the acts and omissions of all subcontractors, their agents and employees, and all other persons acting on behalf of the Contractor or subcontractors as set forth herein. The Owner may require that the Contractor immediately remove from the construction site any employee the Owner or on-site school personnel deem to be incompetent, careless, or otherwise objectionable.

10.2 Qualifications. The Contractor and its subcontractors shall at all times enforce strict discipline and good order among its employees, and shall not employ on the work any person considered by the Architect or the Owner to be unfit or not skilled in the work assigned to him. The Contractor shall also keep its employees and those of its subcontractor from socializing upon the site of the work after normal work hours and from fraternizing at

any time with staff, students, parents, and other persons who are at the school or the site of the work.

10.3 Drug-Free Zone. The Jefferson County School District No. R-1 is a drug-free zone. In furtherance of this standard, the Contractor shall establish and maintain a safe and efficient work environment for all employees, free from the effects of alcohol, controlled substances, and illicit drugs. The use of tobacco products on school district property is prohibited. The manufacture, distribution, dispensing, possession, or use of alcohol, controlled substances, and illicit drugs is prohibited on or adjacent to the project site and all of the Owner's property at all times. Illicit drug use is the use of illegal drugs and the abuse of alcohol and other drugs, including anabolic steroids. Controlled substances are drugs specifically identified and regulated under state or federal law and include, but are not limited to, opiates, narcotics, cocaine, amphetamines and other stimulants, depressants, hallucinogenic substances, and marijuana. The Contractor will strictly enforce this prohibition among its own employees and its subcontractors and their employees at all times. The Contractor and subcontractors shall require all of their employees to undergo drug and alcohol testing if an employee is involved in an accident on the site which may have been caused by human error which could be drug or alcohol related or when a supervisor has reasonable suspicion or notice that the employee shows signs of possible intoxication, use, or is under the influence of drugs, alcohol, or controlled substances. Employees who violate these prohibitions will be subject to disciplinary action by their employers up to and including termination and may be denied access to the site of the work. Violation of this provision shall also constitute sufficient grounds for termination of the Contract or any subcontract without damages or penalty to the Owner.

10.4 Equal Employment. During the performance of this Contract, the Contractor agrees not to discriminate against any employee or applicant for employment because of religion, race, creed, color, sex, sexual orientation, national origin, disability, age, or other legally protected status. The Contractor will take affirmative action to ensure that applicants are employed, and that employees are treated during employment, without regard to their religion, race, creed, color, sex, sexual orientation, national origin, disability, age, or other legally protected status. Such action shall include, but not be limited to, the following: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause. The Contractor will, in all solicitations or advertisements for employees placed by or on behalf of the Contractor; state that all qualified applicants will receive consideration for employment without regard to religion, race, creed, color, sex, sexual orientation, national origin, disability, age, or other legally protected status.

10.5 Criminal Record Verification. Contractor shall not utilize, in the performance of tis contract any laborer or employee who has been convicted of a violent crime or a crime of such nature (i.e. child related offenses) as to categorize the person as being unsuitable for working around school children, or has engaged in such conduct as to be similarly categorized. Contractor shall be required to complete a criminal records check on all employees who work on the project. Employees who have been convicted of a felony, including crimes that require registration on the National Sexual Offender Registry will not be allowed to work on the project. The Contractor must complete and submit the Owner's Criminal Records Check Certification form prior to starting work.

10.5.1 When there is reasonable doubt regarding a particular person's suitability, a request may be made through the Owner for an approval/opinion prior to the individual beginning work. The Contractor shall submit copies of all security/background checks performed within twenty-four (24) hours of a request by the Owner for such information. The Owner may request copies of these security/background checks up to twelve (12) months after completion of the specific project (site work). Failure to complete or submit any required security/background check requested by the Owner, may result in immediate cancellation of work in process and/or removal from the active vendor and bidders list for up to one year.

10.6 The Contractor, its laborers and employees shall not fraternize or otherwise communicate with the students except in cases of safety and like necessities.

10.7 Unless otherwise deemed acceptable by the Owner's Representative, the Contractor shall not allow any employee, subcontractor or persons acting on its behalf to wear clothing or caps with other than company. The Contractor shall not allow any employee to use profanity in any manner while on school property or within the presence of students, staff or the general public.

10.8 The Contractor shall ensure that its laborers and employees fully comply with all school policies/regulations pertaining to restrictions that may affect anyone on school owned property. Examples of these current policies/regulations are:

10.8.1 Each worker shall participate in the contractors approved identification program.

10.8.2 Maintain professional worker like attire (see GC 10).

10.8.3 Controlled substances (i.e. tobacco, alcohol, illegal drugs, dangerous substances) are not allowed on the school/construction site. (Board Policy)

10.8.4 Possession of any weapon, including a pocketknife, which is not directly used as a tool for the work in progress is not allowed on the school/construction site.

10.8.5 Verification of Criminal Records for all employees who work on site per GC 10.

10.9 Removal of a specific person(s) from a project as a result of any condition mentioned above will not relieve the Contractor from timely performance of work completion and will not be considered grounds for a request for additional funds or time extension to complete the project.

10.10 The contractor shall take over and assume all responsibility for the entire premises, provide and maintain all protection as required by the governing laws, rules, regulations and ordinances. The Contractor shall be responsible for any loss or damage caused by its workers to the property of the Owner and shall make good any loss, damage, or injury without cost to the owner, subject to the Builder's Risk Coverages.

10.10.1 Except as otherwise provided in the General Conditions, the Contractor shall be solely responsible for the safety of its work, materials, equipment, tools, etc., on the site and shall, if it deems it necessary or expedient, employ at its own expense the services of a competent security service. The Owner disclaims all responsibilities for the safety of the work, materials, equipment, tools, etc., or for any damage, which may be done to same due to theft, or any other cause until such time as the owner formally accepts the completed work.

10.10.2 The Contractor shall take special precautions against fire and shall comply fully with the requirements of city, county, and insurance authorities including stipulation as outlined below:

10.10.2.1 Combustible refuse shall be removed from the site and disposed of daily in a manner approved by the governing authorities.

10.10.2.2 Private and public streets, sidewalks, roads, etc., shall be protected and maintained during the course of work, and any damage to same shall be repaired by the Contractor at its own expense.

10.10.2.3 Gas line and Boiler work.

10.10.2.4 The Contractor will not do any work on gas lines on or near the building while the building is occupied.

10.10.2.5 No work on the boilers, furnaces, or gas lines will be done without prior notification and approval of the Owner.

10.10.2.6 Boilers and furnaces will not be turned on or off by any Contractor without prior notification and approval of the Owner.

10.10.2.7 When boilers or furnaces are to be turned on or off, the Owner shall be notified in writing and the appropriate Owner personnel will be dispatched to carry out the necessary procedures.

10.10.2.8 The Contractor will be required to accept full responsibility of the keys as issued for access. The contractor will be financially liable for the replacement of lost keys as well as the re-keying of the building to which the keys belong. Contractor agrees to report lost or stolen keys immediately to the Owner. Keys are NOT TO BE DUPLICATED under any circumstances, and Contractor understands that keys must be surrendered immediately upon request.

10.11 Workers without authorization. The Contractor certifies that it shall comply with the provisions of C.R.S. § 8-17.5-101 et seq. The Contractor shall not knowingly (i) employ or contract with a worker without authorization to perform Work under the Contract Documents, (ii) enter into a contract with a subcontractor that knowingly employs or contracts with a worker without authorization to perform Work under the Agreement, or (iii) enter into a contract with a subcontractor that fails to contain a certification to the Contractor that the subcontractor shall not knowingly employ or contract with a worker without authorization to perform Work under the Agreement.

11.0 ROYALTIES AND PATENTS

The Contractor shall pay all royalties and license fees. They shall defend all suits or claims for infringement of any patent rights and shall hold the Owner harmless from loss on account thereof. If the Contractor has information that the process or article specified is an infringement of a patent, it shall be responsible for any and all liability or loss resulting therefrom unless it promptly gives such information to the Architect in writing.

12.0 SURVEYS, PERMITS, LAWS, AND REGULATIONS

12.1 Surveys. As provided by the Owner, the Contractor shall obtain from the Architect a copy of all surveys describing property lines, elevation benchmarks, physical characteristics, and utility locations.

12.2 The State building permit will be secured and paid for by the Owner.

12.3 Any other local permits, governmental fees, and licenses necessary for the proper execution and completion of the work shall be secured and paid for by the Contractor. Easements for permanent structures or permanent changes in existing facilities shall be

secured and paid for by the Owner, unless otherwise specified in writing. The Owner is exempt from paying any fee for any building permit issued by any building departments located in Jefferson County. However, the Contractor shall secure such permit from proper governmental agency if requested by Owner, in which case the cost of any such fee shall be verified and paid by the Owner.

12.4 The Owner will negotiate and provide for all permanent electrical, gas, water, and sewer mains for Contractor's connections. The Contractor is to arrange with the utility company for actual connection, make necessary connections, and pay for all inspection fees and permits in connection therewith as required by any governmental agency. In addition, the Contractor will furnish any material or items as required to complete all connections.

12.5 The Contractor shall coordinate and call for all inspections as required by the State Division of Colorado, Fire Safety, State Division of Oil and Public Safety, State Plumbing, State Electrical, local Fire Authority or any other State or local authority having jurisdiction (AHJ) over the work.

12.6 All other required permits shall be taken out and paid for by the Contractor or respective subcontractor as required by the governing public agency. Unless otherwise stipulated the Contractor shall call and pay for all inspections required by the State, Fire Department or public agencies having jurisdiction over the work.

12.7 Laws and Regulations. The Contractor and all subcontractors shall give all notices and comply with all applicable federal and state statutes, rules, regulations, and directives of the State Division of Fire Prevention and Control, and other governmental body having jurisdiction over the work to be performed. If the Contractor observes that the drawings and specifications are at variance therewith, they shall promptly notify the Owner and Architect in writing and any necessary changes shall be adjusted as provided in the Contract for changes in the work. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules, and regulations, and without such notice to the Owner and Architect, they shall bear all costs arising therefrom and to correct same. The Contractor shall strictly observe and comply with all federal and state laws pertaining to the employment and payment of labor.

13.0 BENCHMARKS, MONUMENTS, STAKES, AND MEASUREMENTS

13.1 Benchmarks. The Contractor shall properly stake out the work and provide and rigidly set benchmarks and batter boards as necessary for the proper performance of the work. The Contractor shall remain responsible for their maintenance and their accuracy. A permanent benchmark, approved as to location and type by the Architect, from which all grades are to be taken, shall be established near the site of the work by the Contractor. From this benchmark the Contractor shall ascertain all grades and levels to the building as needed. The Contract Documents shall include all necessary information to establish the benchmark.

13.2 Preservation of Monuments and Stakes. The Contractor shall carefully preserve all monuments, benchmarks, property markers, reference points, and stakes. In case of its destruction thereof, the Contractor will be charged with the expense of replacement and shall be responsible for any mistake or loss of time that may be caused. Permanent monuments or benchmarks which must be removed or disturbed shall be protected until properly referenced for relocation. The Contractor shall furnish materials and assistance for the proper replacement of such monuments or benchmarks.

13.3 Measurements. Before ordering any material or performing any work, the Contractor shall verify all measurements at the project and shall be responsible for the accuracy of same. No extra charge or compensation shall be allowed because of any difference between actual dimensions and the measurements indicated in the drawings or specifications.

13.3.1 Any discrepancies shall be submitted to the Architect and Owner for consideration before proceeding with the work.

14.0 PROTECTION OF PERSONS, WORK, PROPERTY AND STORMWATER MANAGEMENT

14.1 The Contractor shall take all necessary precautions to ensure the safety of all employees and other persons on the Project or who may be affected by the Contractor's Work thereon. The Contractor shall also take all necessary precautions to protect the Work and all temporary facilities, as well as materials, tools, and equipment incorporated therein or to be incorporated therein from damage or destruction, whether in storage on or off the Project site and whether in the custody or control of the Contractor or any of its subcontractors. The Contractor shall also take all necessary precautions to protect all property at the Project site and adjacent thereto not designated for removal, relocation or replacement, including trees, shrubs, lawns, walks, pavements, roadways, structures, and utilities.

14.2 During the course of construction the Contractor shall maintain free and unimpeded all required exits from the building. Barricades shall be so erected that traffic is separated and protected from the construction. Such exits shall not be closed at any time for any reason while the building is occupied or at any time when the building is unoccupied except after written approval is given by the Owner and proper warning and directional signs are posted.

14.3 The Contractor shall comply with all applicable provisions of the Occupational Safety and Health Administration (OSHA) and all laws, ordinances, rules, regulations, and orders of any public authority having jurisdiction for the safety of persons or property or to protect them from damage, injury, or loss. The contractor shall erect and maintain all necessary safeguards for the safety and protection of workmen, owners, and users of adjacent facilities and the public and shall post danger signs and other warnings against hazards created by such features of construction as protruding nails, hoists, well holes, elevator shafts, hatchways, scaffolding, window openings, stairways, excavations, and falling materials; and shall designate a responsible member of its organization at the site whose duty shall be the prevention of accidents. This person shall be the Contractor's superintendent unless otherwise designated in writing by the Contractor to the Owner and the Architect.

14.4 The Contractor shall be liable for all injury, damage or loss to any person or property caused in whole or in part by the Contractor, any of its subcontractors, or any person employed by or under the direction of the Contractor or any of its subcontractors. To the extent possible and unless otherwise directed by the Owner or Architect, the Contractor shall promptly repair, pay for or otherwise remedy any such injury, damage or loss and shall indemnify and hold harmless the Owner against any and all liability, claims, damages, losses and expenses arising therefrom. The terms of this section shall not apply in the case of injury, damage or loss proximately caused by the acts or omissions of the Owner and/or Architect and not attributable to any fault or negligence of the Contractor.

14.5 In the event of an emergency that threatens the safety or life of any person or threatens to damage or destroy the project and/or any work, materials, equipment or property thereon or to be used thereon, the Contractor shall act at its discretion to prevent such injury, death, damage or destruction. The Contractor shall immediately notify the Owner and Architect in writing of any such emergency and any action taken by the Contractor in response thereto. Any compensation due the Contractor for such emergency action shall be determined by agreement of the Contractor, Owner and Architect, and an appropriate change order shall be issued therefor.

14.6 The contractor is responsible for securing and paying for the State Stormwater Management Permit and/or local Stormwater Management Permit as may be required. The contractor is responsible for ensuring that all the requirements of either the State or local Stormwater Management Permit are strictly followed during construction. The Contractor shall review and follow the Owner's Illicit Discharge reporting procedures in the event of an occurrence.

14.7 The Owner may engage a civil engineer to prepare an erosion control plan as part of the overall contract documents. The Contractor can use or modify the erosion control plan as provided in the contract documents as necessary in its preparation of the Stormwater Management Permit application. However, this does not relieve the Contractor from preparing its own site-specific plan for application submission if no plan is provided in the Contract Documents.

14.8 The Owner or designated owner's representative may inspect the Stormwater Management plan, project site and BMP's and communicate noted deficiencies for corrective measures at any time during the construction project. The Contractor shall be fined up to $250 dollar per day in addition to any Federal, State or local fines until deficiencies are corrected. The Contractor shall coordinate all inspections required by the State or authority having jurisdiction (AHJ).

14.9 The Owners final acceptance of the project and contractor de-mobilization, does not relieve the Contractor of its responsibilities and duties as required in the permit (i.e. maintain BMP's, regular and post event inspections as defined in the permit, etc.) while the permit is still open. Final acceptance of ground areas including permanent stormwater structures shall only occur after the required vegetation and stabilization has been established. At a minimum, unless necessary due to a storm event, the Contractor is required to conduct monthly inspections of the site and BMP's during this warranty period and make corrective changes to the BMP's or add BMP's as needed.

14.10 The Contractor will notify the Owner in writing when it believes all vegetation and stabilization has reached the contract requirements and they want to close the Stormwater Management Permit. The Owner must be allowed the opportunity to review the site and approve the Contractor's request to close the permit. The Contractor shall not apply to close the Stormwater Management permit without the Owners written approval. It is the Contractor responsibility to remove and dispose of all BMP's after the Stormwater Management Permit has been closed.

14.11 The Contractor shall transmit all inspection reports to the Owner within 7 days of each inspection.

15.0 ACCESS TO WORK

15.1 Access. The Architect, the Owner, and their representatives shall at all times have access to the work wherever it is in preparation or progress, and the Contractor shall provide

proper facilities for such access so that the Architect may perform its functions under the Contract Documents.

15.2 Inspection. If the specifications, the Architect's instructions, laws, ordinances, or any public authority require any work to be specially tested or approved, the Contractor shall give the Architect timely notice of its readiness for checking by the Architect or inspection by another authority, and if the inspection is by another authority, of the date fixed for such inspection. All required certificates of inspection shall be secured by the Contractor. If any work should be covered up without approval or consent of the Architect, it must, if required by the Architect, be uncovered for examination at the Contractor's expense.

15.2.1 Re-examination of questioned work may be ordered by the Owner, and if so ordered, the work must be uncovered by the Contractor. If work is found to be in accordance with the Contract Documents, the Owner shall pay the cost of re-examination and replacement. If such work is found not to be in accordance with the Contract Documents, the Contractor shall pay such cost.

15.3 Testing. Materials incorporated into the project will be subject to routine tests as required to ensure their compliance with the specifications. Such tests may include, but shall not necessarily be restricted to, the following: Concrete: primary mix design, slump tests, cylinder compressions tests, and air entrainment tests; Steel: tensile tests; Welds: field inspection and x-ray examination; Soils: sub-soil investigation, physical analysis, and compaction tests; Asphalt pavement: physical analysis and compaction tests; and Roofing-Samples cut from in-place built-up roof.

15.3.1 Any other basic materials for which standard laboratory test procedures have been established may also be included if doubt as to their quality should arise.

15.3.2 Any testing of the above nature will be done at the discretion of the Owner who will bear all costs, unless otherwise provided in the Contract Documents. The Contractor shall be held responsible for coordinating the testing, providing samples of sufficient size for test purposes and for cooperating with the Owner or its representative in obtaining and preparing samples for tests. All tests will be in accordance with standard test procedures and will be performed by persons or firms selected by the Owner.

16.0 CONTRACTOR'S SUPERINTENDENCE AND SUPERVISION

16.1 During the progress of the work unless otherwise specified, the Contractor shall ensure that a competent superintendent and any necessary assistants, all satisfactory to the Architect and the Owner, are on the project site at all times while work is in progress. The Contractor shall not change the superintendent, except with the consent of the Owner and the Architect, unless the superintendent proves to be unsatisfactory to the Contractor and ceases to be in its employ. In the event the superintendent ceases to be in the Contractor's employ and a new superintendent is selected for the Owner's project, that superintendent will meet with the approval of the Owner. The superintendent shall represent the Contractor, and all directions given to superintendent shall be as binding as if given to the Contractor. The Architect and Owner shall not be responsible for the acts or omissions of the superintendent or his/her assistants.

16.2 Unless otherwise specified, the superintendent shall remain on-site full-time through the actual date of final completion, the completion of all punch list items, until the date of the Owner's Letter of Acceptance.

16.3 The Contractor shall provide full-time, qualified, and efficient supervision of the work, using competent skill and attention. The superintendent shall be knowledgeable and have successfully completed training in Stormwater Management & Erosion Control and OSHA construction safety. The superintendent shall be knowledgeable of all building codes that govern the construction of the project. The superintendent shall direct, schedule, and coordinate the work. The superintendent is responsible for determining and supervising all temporary and permanent erection and construction sequences, techniques, means and methods. The superintendent shall coordinate the work to ensure that all parts fit together properly and in accordance with the Contract Documents. The superintendent shall carefully study and compare all Contract Documents and other instructions and shall at once report to the Architect and the Owner any error, inconsistency, or omission which they may discover.

16.4 The superintendent shall see that the work is carried out in accordance with the Contract Documents and in a thorough and first-class manner in every respect.

16.5 The Contractor shall provide engineering, surveying, and coordination to accurately establish all lines, levels, and marks necessary to facilitate the operations of all concerned in the Contractor's work. Contractor shall lay out the work in a manner satisfactory to the Architect, making permanent records of all lines and levels required for excavation, grading, and foundations, and for all other parts of the work. Contractor shall determine the commencement and certify the proper completion of the various stages of construction.

17.0 CHANGES IN THE WORK

17.1 Change Orders. The Owner may, at any time, by a written change order directed through the Architect, without notice to the sureties and without invalidating the Contract, make changes in the drawings and/or specifications of this Contract within the general scope thereof; order extra work; or make changes by altering, adding to, or deducting from the work. If such changes cause an increase or decrease in the amount due under this Contract, or in the time required for its performance, an equitable adjustment shall be made on the change order, and the Contract shall be modified in writing accordingly. Any claim of the Contractor for adjustment under this clause must be asserted in writing within ten (10) days from the date of receipt by the Contractor of the notification of change. No change order or other form of order or directive by the Owner or Architect requiring additional compensable work to be performed, which causes the aggregate amount payable under the Contract Documents to exceed the amount appropriated for the original Construction Agreement shall be issued unless the Contractor is given written assurance by the Owner that lawful appropriations to cover the costs of the additional work have been made.

17.2 Minor Changes. In giving instructions, the Architects shall have authority to make minor changes in the work, which do not involve extra cost, and which are not inconsistent with the the intent of the Contract Documents. Otherwise, except in an emergency endangering life or property, no extra work or change shall be made unless such extra work or change is pursuant to a written order from the Owner signed or countersigned by the Architect, or a written order from the Architect stating that the Owner has authorized the extra work or change. No claim for an addition to the Contract sum shall be valid unless ordered or authorized in the manner set forth in this paragraph.

17.3 Price Differential. The cost or credit resulting from a change in the work shall be determined in one or more of the following ways:

17.3.1 By estimate, with a detailed cost breakdown as set forth in subparagraph 17.3.3. below, and acceptance in a lump sum, with a maximum combined mark-up to the Owner, for the Contractor and all affected subcontractors, not to exceed a total of fifteen percent (15%). Overhead, profit and additional fee on work performed by subcontractors shall include insurance premiums not itemized above, cost of office supervision and assistants, incidental job burdens, and general office expense. The base for applying percentages shall not include the social security tax. Such percentages are as follows:

17.3.1.1 To subcontractors and/or to the contractor for work performed with its own forces, will receive such portion of the Contractor's fee as may be agreed and paid to them by the Contractor.

17.3.1.2 On proposals involving both increases and decreases in the amount of the contract, the overhead, profit and fee will be allowed on any net increase only.

17.3.2 By unit prices named in the Contract or subsequently agreed upon.

17.3.3 If the parties are unable to agree on one of the above methods, then the amount shall be determined by force account under the following formula:

17.3.3.1 The actual cost of all direct labor performed (including foremen employed continuously on the work, but not the salary, or any part thereof, of the Contractor's superintendent) and the actual materials furnished for and used in such work, less all available cash, trade, or other discounts;

17.3.3.2 Rental for the use of such items of equipment as have an individual value in excess of Two Thousand Dollars ($2,000); provided that the amount of such rental charge and the length of time and probable cost of the use of such equipment shall have been authorized in writing by the Owner;

17.3.3.3 All proportionate sums paid for royalties, permits, and inspection fees;

17.3.3.4 All proportionate premiums for Public Liability Insurance, Worker's Compensation, and other proper and necessary insurance, as well as all applicable payroll taxes;

17.3.3.5 Either a predetermined lump sum, fixed fee, or a maximum combined fee for the contractor and all affected subcontractors of fifteen percent (15%), which fee shall be applied to the total of paragraphs 17.3.3.1, 17.3.3.2, and 17.3.3.3 only, and shall constitute full compensation to the Contractor for all costs and expenses, including all overhead and profit, which are not otherwise enumerated above. Subcontractors, if employed by the Contractor on this part of the work, will receive such portion of the Contractor's fee as may be agreed and paid to them by the Contractor.

17.3.3.6 The Contractor shall keep and present, in such manner as the Owner may direct, an accurate accounting of all of the foregoing costs, together with all supporting vouchers and other documentation, all subject to audit by the Owner.

18.0 CLAIMS FOR EXTRA COST OR ADDITIONAL TIME AND WAIVER OF CONSEQUENTIAL DAMAGES

18.1 Claims for Extra Cost or Time. If the Contractor claims that any instructions by drawings or otherwise, after the date of the Contract, involve extra costs under this Contract which were not included in the original bid, or requires an extension in the Contract time, it shall give the Owner and the Architect written notice thereof no later than seven (7) days after the receipt of such instructions, and in any event before proceeding to execute the work, except in an emergency endangering life or property, and the procedure shall then be as provided for changes in the work. No such claim shall be valid unless so made. Any change in the Contract amount or Contract time must be authorized by change order prior to the execution of the work.

18.2 Delays and Extensions of Time. If the Contractor is delayed at any time in the progress of the work by any act or neglect of the Owner or the Architect, or by any employee of either, or by any separate contractor employed by the Owner, or by changes ordered in the work, or by unavoidable casualties, or by any cause which the Owner determines may justify the delay, then the completion date shall be extended by change order for such reasonable time as the Owner may determine.

18.2.1 If unusually severe weather conditions are a basis for a claim for additional time, the weather experienced at the project site during the time of completion for the Project must be found to be a greater magnitude than the anticipated adverse weather for the area specific to the project during any given month. Such claim shall be documented by the contractor by data substantiating that weather conditions were unusually severe in comparison to the thirty (30) year average established by the climatologically data, U.S. Department of Commerce, for the area specific to the project and could not have been reasonably anticipated. The unusually severe weather must actually cause a delay to the completion of the Project by preventing work on Critical Path scheduled activities for fifty-one (51%) or more of the Contractor's scheduled workday. The delay must be beyond the control and without the fault or negligence of the contractor. If the unusually severe weather delay days encountered exceed the thirty (30) year average, either a time extension for an equitable number of days or costs for schedule recovery will be considered by the Owner.

18.2.2 If unusually adverse weather conditions are a basis of a claim for additional time, the weather experienced at the Project site during the time of construction of the Project adverse weather conditions must exceed the historical adverse weather conditions based on the National Oceanic and atmospheric Administration (NOAA) for the project area and will constitute the base line for monthly weather time evaluations. All subsequent monthly updates of the Contractor's project schedule will incorporate these anticipated adverse weather delays in all weather dependent activities. Actual adverse weather delays must prevent work on critical path schedule activities for fifty-one (51%) or more of the contractor's scheduled workday. The number of actual adverse weather delay days shall include days impacted by actual adverse weather (even if adverse weather occurred in the previous months), be calculated chronologically from the first to the last day of each month, and be recorded as full days. If the actual cumulative number of adverse weather delay days encountered exceed the number of anticipated above, giving full

consideration for equivalent fair weather calendar days, either a time extension for an equal number of day or costs for schedule recovery will be considered by the Owner.

18.2.3 All requests for extension of time shall be subject to the Owner's approval and shall be made in writing to the Owner no more than seven (7) days after the occurrence causing the delay; otherwise they shall be waived. Any request for extension of time for a change in the work or for any occurrence allegedly causing a delay as provided for herein must be substantiated by demonstrating the effect of the change or occurrence on the critical path of the Construction Schedule.

18.2.4 If no schedule or agreement is made stating the dates upon which written interpretations or detail drawings shall be furnished, then no claim for delay shall be allowed on account of failure to furnish such interpretations or drawings until fifteen (15) days after demand is made for them, and not then unless such claim is reasonable.

18.2.5 Should the time for completion of the Contract be extended, the Owner reserves the right to occupy any part of the structure upon written notice to the Contractor from the Architect or the Owner, but only after the Architect has made a thorough inspection accompanied by the Contractor's superintendent to note any defects in workmanship or materials which are the responsibility of the Contractor. Any such partial occupancy shall not be deemed a waiver of any provision for liquidated damages for delay in final completion.

18.2.6 When the whole or a portion of the work is suspended for any reason, each Contractor shall properly cover over, secure, and protect all work as may be susceptible to damage from any cause.

18.3 This Article does not exclude the recovery of damages by the Owner for delay under other provisions of the Contract Documents.

18.4 Waiver of Consequential Damages. Except as may otherwise be provided in the agreement and/or General Conditions for liquidated damages, the Contractor and the Owner waive claims against each other for consequential damages arising out of or relating to the contract, including, without limitation, all consequential damages due to the Owner's termination of the contract.

19.0 HAZARDOUS MATERIALS

19.1 If the Contractor becomes aware of the presence of hazardous materials in any form at the project site including, but not limited to, asbestos or other toxic substances it shall, prior to commencement of any portion of the work, provide notice to the Owner of the presence, location, and condition of any known or suspected materials that are discovered. Such notice shall be in writing and shall be submitted no more than twenty-four (24) hours after such materials are discovered.

19.2 In the event of such discovery not previously identified by the Owner, the Contractor shall not proceed with the Work until they have received written authorization from the Owner. If the Contractor proceeds with the Work without said authorization, it does so at its own risk.

19.3 In the event such materials are identified or encountered during the course of the Project, the Owner, at its expense, shall take all reasonable actions to properly and safely deal with such materials.

19.4 Prior to the start of site investigation or construction the Contractor shall acknowledge that the Contractor, its employees and agents, have reviewed the Owner's

Management Plan as it relates to the buildings located at the Project site and shall consult with the Owner about how such plan addresses suspected or active asbestos containing material areas within such buildings. The Contractor assumes responsibility for notification to workers of existing asbestos conditions. Notification shall be made on approved EPA forms and includes posting of notices in accordance with OSHA, EPA and State Health Department guidelines.

19.5 All MSDS documents required by Federal and State law shall be kept available on site in the contractor's trailer or office.

19.6 All hazardous material and waste shall be secured, contained (secondary containment as necessary), labeled properly and used or disposed of in accordance with local, State and Federal regulations.

19.7 The contractor shall be responsible for spill containment, clean up and any other associated costs resulting from an illicit discharge of hazardous materials or waste. The contractor shall review, understand and follow the Owner's illicit discharge reporting procedures.

20.0 CHANGED CONDITIONS

The Contractor shall promptly, and before such conditions are disturbed, notify the Owner and the Architect in writing of: (1) sub-surface or latent physical conditions at the site differing materially from those indicated in the Contract Documents, or (2) unknown physical conditions at the site, of an unusual nature, differing materially from those ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents. The Owner and the Architect shall promptly investigate the conditions, and if the Owner finds that such conditions do so materially differ and cause an increase or decrease in the cost of, or the time required for, performance of the work, an equitable adjustment shall be made and the Contract modified in writing accordingly. Any claim of the Contractor for adjustment hereunder shall not be allowed unless Contractor has given notice as above required. Such claim for adjustment shall be subject to the Owner's approval and shall be made in writing to the Owner no more than seven (7) days after the identification of the conditions; otherwise such claim shall be deemed waived.

21.0 CORRECTION OF WORK

21.1 Correction of Work Before and After Completion. The Architect or Owner has the authority to condemn work, which is defective or does not conform to the Contract Documents. The Contractor, following written demand, shall promptly correct all work rejected by the Architect or Owner as defective or as failing to conform to the Contract Documents whether observed before or after final completion and whether or not fabricated, installed, or completed. The Contractor shall bear all costs of correcting such rejected work, including the cost of the Architect's and/or Owner's consultant's additional services. If the Contractor proceeds to build in or cover the item, which has been rejected, it shall be totally responsible for the cost of removal and replacement of said item and removal and replacement of all necessary work surrounding or covering the item in order to produce a first-class job.

21.2 Tests to Determine Conformance. Whenever in the opinion of the Architect or the Owner, tests are essential to assure the professional evaluation of the work, which is subject to being rejected or condemned, the necessary number of tests will be performed by the consultants designated by the Owner. The recommendation of this consultant is final and all

parties to the Contract will comply with the methods and extent of the corrections submitted in writing to the Owner and the Architect by the designated consultant. The cost of the tests will become the Contractor's responsibility if corrections of any nature are recommended by the consultant to the investigated work; otherwise, the Owner will pay for all tests performed. Should such special testing, inspection, or approval be caused by the Contractor's failure to follow the requirements of the Contract Documents or of required tests under GC 15 testing indicating conditions not in conformance with the Contract Documents, the costs of such additional testing, inspection, or approval shall be borne by the Contractor, regardless of the results.

21.3 Removal of Rejected Work. The Contractor shall promptly remove from the premises all work rejected by the Architect or Owner as failing to conform to the Contract Documents whether physically in place or not. Thereafter, the Contractor shall promptly replace and re-execute such work in accordance with the Contract and without expense to the Owner. The Contractor shall further bear the expense of making good all work of other subcontractors found to be defective or destroyed or damaged by such removal or replacement.

21.3.1 If the Contractor does not remove such rejected work within a reasonable time, fixed by written notice from the Owner through the Architect, the Owner may remove it and may store the material at the expense of the Contractor. If the Contractor does not pay the expenses of such removal within ten (10) days' time thereafter, the Owner may, upon ten (10) days' written notice, sell such materials at auction or at private sale. In such case, the Owner shall account to the Contractor for the net proceeds thereof, after deducting all the costs and expenses that should have been borne by the Contractor, including compensation for additional Architect or consultant services. If the net proceeds of sale do not cover all costs, which the Contractor should have borne, the difference shall be charged to the Contractor and an appropriate change order shall be issued. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner. In addition, the Owner shall have any other remedies that may be available to it.

21.4 Correction of Work After Final Payment. Neither the final estimate nor payment nor any provision in the Contract Documents shall relieve the Contractor of responsibility for faulty materials or workmanship and, unless otherwise specified, they shall remedy any defects due thereto and pay for any damage to other work or property resulting therefrom, which shall appear within a period of one (1) year from the date of final completion and acceptance. This warranty shall be in addition to and not in lieu of all other remedies available to the Owner.

21.5 Failure to Correct the Work. If the Contractor fails to correct such defective or nonconforming work, the Owner may correct it and otherwise proceed against the Contractor for the cost thereof in accordance with the provisions of these General Conditions.

21.6 Deductions for Uncorrected Work. If the Owner deems it inexpedient to correct work that has been damaged or is defective or has not been completed in accordance with the Contract Documents, an appropriate deduction from the Contract price shall be made and reflected by a change order, or, if the amount is determined after final payment, it shall be paid by the Contractor.

21.7 Additional Obligations. The obligations of the Contractor to correct the work shall be in addition to, and not in limitation of, any other obligations imposed upon them by law, special guarantees, warranties, or other rights of the Owner.

22.0 OWNER'S RIGHT TO CARRY OUT WORK

If the Contractor should neglect to prosecute the work properly or fail to perform any provision of this Contract, the Owner, after three (3) working days' written notice to the Contractor, may, without prejudice to any other remedy they may have, make good such deficiencies and may deduct the reasonable cost thereof from the payment then or thereafter due the Contractor. In the event such work is performed by the Owner, the Owner's employees, or by persons other than the Contractor at the Owner's request, the Owner shall not be liable to the Contractor for inconvenience expense or subsequent cost of removal of such work. The amount to be deducted as cost of doing the work shall include the cost of the Architect's additional services made necessary by such default. If the payments then or thereafter due the Contractor are not sufficient to cover such amount, the Contractor shall pay the difference to the Owner.

23.0 OWNER'S RIGHT TO TERMINATE CONTRACT

23.1 With Cause. If the Contractor should fail to perform the work with reasonable and due diligence or refuse to supply sufficient skilled works or materials of the proper quality, or should the contractor be adjudged a bankrupt; or it should make a general assignment for the benefit of its creditors without approval of the Owner; or if a receiver should be appointed on account of its insolvency; or if it should refuse or should fail, except in cases for which extension of time is provided; or if it should fail to make prompt payment to subcontractors or for material or labor; or disregard laws, ordinances, or the instructions of the Architect or Owner; or otherwise be guilty of a material violation of any provision of the Contract; then the Owner, when in its sole opinion sufficient cause exists to justify such action, may, without prejudice to any other right or remedy and after giving the Contractor, and its surety, if any, seven (7) days' written notice, terminate the employment of the Contractor and take possession of the premises and of all materials, tools, and appliances thereon and finish the work by whatever method the Owner may deem expedient. In such case the Contractor shall not be entitled to receive any further payment until the work is finally completed and accepted by the Owner. If the unpaid balance of the Contract sum shall exceed the expense of completing the work, including compensation for additional architectural, managerial, consultant, and administrative services, such excess shall be paid to the Contractor. If such expense shall exceed such unpaid balance, the Contractor and its surety, if any, shall pay the difference to the Owner. The expense incurred by the Owner, as herein provided, and the damages incurred through the Contractor's default, shall be determined by the Owner.

23.2 Without Cause. Should conditions arise which in the Owner's opinion make it necessary or advisable to discontinue work under the Contract Documents, the Owner may terminate the Contract in whole or in part without cause or fault by the Contractor by giving seven (7) days' written notice to the Contractor. The notice shall specify the date and extent to which the Contract is terminated. Upon any such termination, the Owner shall take possession of the site and all or any part of the materials and equipment delivered or en route to the site. In the event of termination under this paragraph the Contractor shall be equitably paid for all work properly completed and materials and equipment in conformance with

contract documents properly secured at the project site, based upon the approved Schedules of Values.

24.0 PAYMENT

24.1 Schedule of Values. Payments will be made on the valuation of the work done. Before any Request for Payment will be considered, the Contractor shall submit to the Architect and the Owner a complete, itemized schedule of the values of the various parts of the work, aggregating the total sum of the Contract and separating labor, material, and equipment costs from Overhead and Profit costs. Such schedule shall include as costs the material costs of all subcontractors under such Contractor and the costs of all materials to be taken from the Contractor's or subcontractors' own stocks of material. The schedule shall be submitted on forms supplied by the Owner and, if required, supported by such evidence as to its correctness as the Architect or the Owner may direct. Each item on the schedule of values shall include its proper share of overhead and profit. This schedule will be used for the estimates and payments provided for in General Conditions. Along with such schedule the Contractor shall submit a schedule of these values of estimated monthly application amounts for the course of the work to assist the Owner in arranging payment.

24.2 Payments to Contractors. Partial payments will be made as the work progresses within fifteen (15) days of the Owner's receipt of the Application for Payment of Contractor, which is properly completed and has been approved by the Architect. If the Owner has an issue with or does not approve the Application for Payment of Contractor, the Owner will notify the contractor in writing. Request for Payment shall be submitted to the Architect on a regularly established monthly schedule approved by the Owner. The Owner reserves the right to withhold payments at any time regardless of the Architect's recommendations. The Request for Payment shall be based on the same items as shown in the schedule of values itemizing the material used and work performed for which payment is claimed. In preparing estimates, material delivered and properly stored on the site and preparatory work done may be taken into consideration.

24.2.1 If payments are made on account of materials not incorporated in the work, but delivered and suitably stored at the site, or at some other location that is bonded and insured and agreed upon in writing, such payments shall be conditioned upon submission by the Contractor of bills of sale or such other procedures which will establish the Owner's interest, including applicable insurance and transportation to the site.

24.2.1.1 Off site stored material must be made available for inspection by owner, architect, consultants and/or contractor prior to pay applications being approved.

24.2.1.2 Material must be clearly identified as property of owner, and stored in a manner as to be easily distinguished from general inventory. This may include the actual development of an area that can be fenced off from other inventory.

24.2.1.3 Request for payment will include all applicable invoices, a bill of sale and a certificate of insurance which states the dollar amount of the stored material. All dollar amounts on invoices, the bill of sale and the insurance certificates shall match exactly the amount being billed for on the application. The insurance certificate must also name the owner as additionally insured.

24.2.1.4 When requested by owner or architect, general contractor will set up the inspection meeting and general contractor will be present at inspection.

24.2.1.5 Payment applications for shop drawings will be allowed, but not approved for payment until the shop drawings have been submitted to architect, approved by both architect and owner and all corrections have been completed.

24.2.2 Per C.R.S. 24-91-103, payments will be made in the full value of the work performed and material stored less five percent (5%) of such value which shall be retained until completion and acceptance of all work, unless otherwise agreed by Owner, and less the aggregate of any previous payments. Upon satisfactory completion and final acceptance of each separate building or portion of the building or other division of the Contract upon which agreement has been reached as to its separate price, the Owner may make payment in full, including retained percentages thereon less deductions as determined by the Owner. Before such payment is made, the Owner shall determine that satisfactory and substantial reasons exist for the payment and shall require written approval from any surety furnishing bonds for the work. Partial and final payments by the Contractor to their subcontractors shall be made in the same manner as provided herein between the Owner and the Contractor.

24.2.3 Per C.R.S. 24-91-105, under any Contract exceeding One Hundred Fifty Thousand Dollars ($150,000), pursuant to which sums are withheld to assure satisfactory performance, the Contractor may withdraw the whole or any portion of such sums withheld if the Contractor deposits acceptable securities with the Owner in an amount at all times at least equal to the amount withdrawn. All such withdrawals shall be on the Owner's approved forms and shall require that the acceptable securities be endorsed in favor of the Owner, authorizing the Owner to negotiate the acceptable securities and to receive the payments due.

24.2.4 The Contractor warrants and guarantees that title to all work, materials, and equipment covered by a Request for Payment, whether incorporated in the project or not, will pass to the Owner upon the receipt of such payment by the Contractor, free and clear of all liens, claims, security interests, or encumbrances; and that no work, materials, or equipment covered by a Request for Payment will have been acquired by the Contractor or by any other person performing the work at the site or furnishing materials and equipment for the project, subject to an agreement under which an interest therein or an encumbrance thereon is retained by the seller or otherwise imposed by the Contractor or such other person. This provision shall not be construed as relieving the Contractor from the sole responsibility for all materials and work upon which payments have been made or the restoration of any damaged work or as a waiver of the right of the Owner to require the fulfillment of all the terms of the Contract.

24.3 Certificates for Payments. No Request for Payment shall be submitted to the Owner until and unless it has been certified by the Architect. No Certificate for a progress payment, nor any progress payment, nor any partial or entire use or occupancy of the project by the Owner shall constitute an acceptance of any work not completed in accordance with the Contract Documents.

24.4 Payments Withheld. The Owner may withhold payment or the Architect may decline to issue a Certificate for Payment in whole or in part, or the Architect may withhold or

nullify the whole or any part of any Certificate previously issued, because of subsequently discovered evidence or subsequent inspections, for such an amount or to such extent as may be necessary in the opinion of either to protect the Owner from loss on account of:

24.4.1 Defective work not remedied;

24.4.2 Claims filed or reasonable evidence indicating probable filing of claims;

24.4.3 Failure of the Contractor to make payments properly to subcontractors or material or labor;

24.4.4 A reasonable doubt that the Contract can be completed for the balance then unpaid;

24.4.5 Damage to another contractor;

24.4.6 Failure of the Contractor to prosecute any portion of the work in a timely manner or in compliance with any approved schedules;

24.4.7 Failure of the Contractor to submit on a timely basis any documentation required by the Contract Documents, including, without limitation, monthly schedule status updates, schedule of values, current as-built documentation, or request for approval of subcontractors.

25.0 CONSTRUCTION SCHEDULE AND PROGRESS REPORTS

25.1 The Contractor shall submit, prior to Notice to Proceed in a format acceptable to the Owner, a construction schedule for the project. This schedule shall start with the date of the Notice of Contract Award, and the completion date shall be the date specified in the Construction Agreement. The schedule shall portray fully a timetable representing the various activities in the schedule of values and shall include submittal schedule and long lead material activities. The schedule shall include all Owner activities that may affect the progress of work such as academic testing dates, student registration, no school, teacher in-service, etc. The contractor's schedule shall include activity dependencies and logic to clearly indicate the projects Critical Path activities. The time shown between the starting and completion dates of the various activities within the schedule shall represent one hundred percent (100%) completion of each activity. Additional detailed schedules of separate activities of work may be requested at the Owner's discretion. No Request for Payment will be accepted by the Owner until this schedule has been submitted as required herein. This schedule shall be revised at a minimum every month during the progress of the work or when the actual progress, in the opinion of the Architect or the Owner, varies materially from the last monthly schedule status update. At each weekly Owner, Architect, Contractor meeting the Contractor is required to present a 3 week short interval schedule detailing the upcoming work.

25.2 The Contractor shall submit with its "Application of Payment for Contractor" the monthly statused schedule reflecting the work in place. The monthly statused schedule shall depict progress and percentage of completion of activities consistent with the values and amounts contained in the "Application of Payment for Contractor". The Contractor's subcontractors shall be supplied copies of the accepted schedule. Failure to submit a monthly statused schedule update shall be deemed cause to reject Requests for Payment or to withhold partial payment as deemed necessary by the Owner.

25.3 The Contractor shall schedule all work so as to reduce to a minimum any disruption in the use of the existing facilities and interruptions of utility service of any type. Where electrical or mechanical work performed under this Contract will necessitate interruptions of service to existing facilities, the Contractor shall furnish and install temporary service to

such facilities or perform such work at such times when said existing utilities are not in normal use. This Contractor shall bear the cost of all overtime or inconvenience resulting therefrom.

26.0 INSURANCE

26.1 The Contractor shall purchase and maintain, without interruption, throughout the term of the Contract and for a period of one (1) year following the date of Final Acceptance of the Work, such insurance as will protect it from claims set forth below which may arise out of or result from the Contractor's operations under the Contract, whether such operations be by itself or by any subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable. The Contractor shall provide evidence of such coverage to the Owner on an annual basis during the aforementioned period including all of the terms of the insurance and indemnification requirements of this Construction Agreement. Such certificates shall specifically state the inclusion of the coverages and the provisions set forth herein and shall state whether the coverage is "claims made" or "per occurrence". If the coverage is written on a "claims made" basis, Contractor shall confirm that any retroactive date for the coverage precedes the effective date of the Construction Agreement and is in effect for a period of three years from the date of final acceptance of the Work. All such insurance shall be subject to the approval of the Owner for adequacy of protection. The contractor shall ensure that any cancellation or change in insurance shall be made in writing to the Owner thirty (30) days' prior the change.

26.2 During the term of the Contract and for a period of one (1) year following the date of Final Acceptance of the Work, the Contractor shall not cancel or refuse to renew the liability insurance required above without the written approval of the Owner, which approval may be withheld at the sole discretion of the Owner. With each Request for Payment submitted by the Contractor, the Contractor shall submit an updated and current certificate of insurance or other evidence, to the reasonable satisfaction of the Owner, evidencing the liability insurance coverage required herein. The Contractor shall notify the Owner immediately upon receipt of any notice from the insurer of any cancellation, termination, or non-renewal of the policy.

26.3 Contractor's Commercial General Liability Insurance Requirements. The Contractor shall procure and maintain, at its own expense, Contractor's Commercial General Liability Insurance as hereinafter specified. The liability insurance shall be issued to the Contractor and protecting it from all claims for bodily injury, including death, and property damage arising out of or in connection with any operations under this Construction Agreement, whether such operations be by itself or by a subcontractor under it, or anyone directly or indirectly employed by the Contractor or by a subcontractor under it, or by anyone for whose acts by them may be liable.

26.3.1 All such insurance shall be written with a limit of liability in the amount identified in the Summary of Contract Terms for all damages arising out of bodily injury, including death, at any time resulting therefrom, and property damage up to the amount specified in the Summary of Contract Terms.

26.3.2 The following coverages shall be included in the Commercial General Liability Insurance:

26.3.2.1 Per project general aggregate (CG 25 03 or similar)

26.3.2.2 Owner, its subsidiary, parent, associated and/or affiliated entities, successors or assigns, its elected officials, trustees, employees, agents, and volunteers shall be named as Additional

Insureds with respect to liability and defense of suits arising out of the activities performed by, or on behalf of the Contractors, including completed operations, and must include both ONGOING Operations and COMPLETED Operations per CG2010 10/01 and CG 203710/01 or equivalent as permitted by law.

26.3.2.3 The policy shall be endorsed to be primary and non-contributory with any insurance maintained by Additional Insureds.

26.3.2.4 Additional Insured – Owners, Lessees or Contractors Endorsement (ISO Form 2010 2004 edition or equivalent)

26.3.2.5 Additional Insured – Owners, Lessees or Contractors Endorsement (ISO CG 2037 20014 edition or equivalent)

26.3.2.6 A waiver of subrogation in favor of all Additional Insured parties.

26.3.2.7 Personal/Advertising Injury Liability

26.3.2.8 Contractual Liability coverage to support Contractor's indemnification obligations

26.3.2.9 Explosion, collapse and underground (xcu)

26.3.2.10 Independent contractors

26.3.2.11 Products/Completed Operations

26.3.2.12 Premises and Operations

26.3.2.13 Designated Construction Projects General Aggregate Limit (ISO CG 2503-1997 edition or equivalent.

26.3.3 The following exclusionary endorsements are prohibited in the Commercial General Liability Insurance policy:

26.3.3.1 Damage to Work performed by Subcontract/Vendor (CG 22-94 or similar)

26.3.3.2 Contractual Liability Coverage Exclusion modifying or deleting the definition of an "insured contract" from the unaltered SO CG 0001 1001 policy from (CG 2426 or similar)

26.4

26.5 Workers' Compensation Insurance. The Contractor shall maintain at its own expense, until completion of the work and final acceptance thereof by the Owner, Workers' Compensation Insurance, including occupational disease provisions, covering the obligations of the Contractor in accordance with the provisions of the laws of the State of Colorado and Employer's Liability as defined in the Summary of Contract Terms. Such policy shall contain a waiver of subrogation in favor of the Owner. It is the Contractor's responsibility to ensure that its subcontractors and suppliers shall require that all Workers' Compensation Insurance rights of recovery against the owner, including any insurance rights subrogation against the Owner are expressly waived, and to the extent not furnished, the Contractor accepts full liability and responsibility for subcontractor's employees. The Contractor shall furnish the Owner with a certificate giving evidence that the Contractor is covered by the Workers' Compensation Insurance herein required, each certificate specifically stating that such insurance includes occupational disease provisions. All such certificates shall be furnished within ten (10) days after the date of the Notice of Award.

26.6 Builder's Risk Completed Value Insurance/Installation Floater Insurance. The Owner shall pay for and maintain Builder's Risk Completed Value Insurance/Installation Floater Insurance, insuring property of every kind and description to be incorporated into the work,

including materials and supplies, used or to be used, as part of or incidental to the construction operations. The insurance shall exclude the Contractor's and its subcontractors' equipment, tools, and machinery, or any other items of any description that are not incorporated into the work. Faulty workmanship shall also be excluded. The Builder's Risk Insurance shall provide coverage against physical loss or damage caused by fire, theft, vandalism, malicious mischief, collapse, and "extended coverages." The insurance shall include a minimum deductible of $5,000. The Contractor shall pay costs not covered because of such deductibles. The Builder's Risk Insurance shall remain in effect until 12:00 noon on the day following the date of the final acceptance of the entire project, whether or not the project or some part thereof is occupied in any manner prior to such final acceptance.

26.6.1 A loss insured under the Owner's Builder's Risk Insurance shall be adjusted by the Owner and made payable to the Owner on behalf of the Contractor and its subcontractors as their interests may appear. The Contractor shall pay subcontractors their just portions of any insurance proceeds received by the Owner and paid to the Contractor.

26.6.2 Unless the Owner agrees otherwise, in writing, all monies received shall be applied toward rebuilding or repairing the destroyed or damaged work.

26.6.3 The Contractor and its subcontractors and suppliers waive all rights against the Owner for damages caused by fire or other perils to the extent covered by the Builder's Risk Insurance obtained pursuant to this section or other property insurance applicable to the work, except such rights as they may have to the proceeds of such insurance held by the Owner on their behalf. The Contractor shall require similar waivers of its subcontractors, sub-subcontractors, agents, and employees of any of them.

26.7 Comprehensive Automobile Liability. The Contractor shall pay for and maintain Comprehensive Automobile Liability Insurance, including owned, non owned, and hired vehicles in the following amounts:

26.7.1 Bodily Injury and Property Damage as defined in the Summary of Contract Terms.

26.7.2 If approved in writing by the Owner prior to the execution of the Agreement, a general liability non-owned automobile endorsement may be accepted for non-owned automobile operations, which are incidental to the project.

26.7.3 If approved in writing by the Owner prior to the execution of the Agreement, personal automobile liability insurance may be approved for incidental automobile operations for specifically identified individuals working on the project.

26.8 Contractor’s Pollution Liability

26.8.1 The Contractor shall procure and maintain, at its own expense, Contractor's Pollution Liability Insurance as hereinafter specified. The liability insurance shall be issued to the Contractor protecting it from all claims that involve pollution risk to the environment or losses caused by pollution conditions, including asbestos, with coverage for bodily injury, property damage, defense costs, clean up costs, and completed operations that arise from the operations of the Contractor as described in the Scope of Services section of this contract, whether such operations be by itself or by a subcontractor under it, or anyone directly or indirectly employed by the Contractor or by a subcontractor under it, or by anyone for whose acts by them may be liable. Policy shall cover the Contractor’s completed operations. Coverage shall

apply to sudden and gradual pollution conditions resulting from the escape of release of smoke, vapors, fumes, acids, alkalis, toxic chemicals, liquids, or gases, natural gas, waste materials, or other irritants, contaminants, or pollutants (including asbestos).

26.8.2 Policy shall provide for provide for complete professional service coverage, including coverage for pollution liability that is the result of a breach of professional duties.

26.8.3 The policy shall provide for cleanup costs when mandated by governmental entities, when required by law, or as a result of third-party claims.

26.8.4 If the coverage is written on a claims-made basis, the Contractor warrants that any retroactive date applicable to coverage under the policy precedes the effective date of this Contract; and that continuous coverage will be maintained or an extended discovery period will be exercised for a period of three (3) years beginning from the time that work under this contract is completed.

26.8.5 The policy shall be endorsed to include the following as Additional Insured requirements: "Owner, its subsidiary, parent, associated and/or affiliated entities, successors, or assigns, its elected officials, trustees, employees, agents, and volunteers named as an additional insured with respect to liability and defense of suits arising out of the activities performed by, or on behalf of the Contractor, including completed operations".

26.8.6 If the Scope of Services in this Contract requires the transportation of any hazardous material or regulated substances, the Contractor shall carry Automobile Liability with a CA 9948 endorsement (or its equivalent)

26.8.7 All such Contractor's Pollution Insurance shall be written with a limit of liability in the amount identified in the Summary of Contract Terms for all damages arising out of bodily injury, including death, at any time resulting therefrom, and property damage up to the amount specified in the Summary of Contract Terms.

26.9 The parties hereto understand and agree that the additional insured Owner is relying on and does not waive or intend to waive by this Contract any provision hereof, including the provision of this section, the monetary limitations, or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, C.R.S. 24-10-101 et seq., as from time to time amended, or otherwise available to the Owner.

26.10 With each Request for Payment submitted by the Contractor, the Contractor shall submit an updated and current certificate of insurance or other evidence, to the reasonable satisfaction of the Owner, evidencing the liability insurance coverage required herein. The Contractor shall notify the Owner immediately upon receipt of any notice from the insurer of any cancellation, termination, or non-renewal of the policy.

26.11 Insurance Companies. The Owner will accept the policies written only by insurance companies legally authorized in the State of Colorado and rated in Best's Insurance Guide (latest edition), not lower than A- or have a Best's Financial Rating of at least X.

26.12 The Contractor accepts full responsibility for confirmation of any subcontractor required insurance coverage

26.13 The Owner does not in any way intend to limit liability limits beyond its minimum requirements contained in this contract. Should the contractor choose to provide limits in excess of the required limits. No other limitations of liability, except for those contained and specified in the Summary of Contract Terms section identifying the required insurance liability limits, shall be allowed under this contract.

26.14 If professional liability, commercial general liability, contractor's pollution liability, or contractor's pollution legal liability is provided via a claims made policy, coverage must remain in force with a one year extended reporting period from the date of final acceptance. All extended reporting periods or coverage extensions shall be confirmed in writing with the Owner. For all cancelled and/or nonrenewed "claims made" policies, the CONSULTANT shall purchase "tail" coverage that will remain in effect for a minimum of one year following the cancellation/nonrenewal/expiration date of the policy or the date of final acceptance. The OWNER must be named as an additional insured on this "tail" coverage for commercial general liability and contractor's pollution liability.

27.0 PERFORMANCE AND PAYMENT BONDS

27.1 The Contractor shall, within ten (10) days of the Notice of Contract Award, furnish bonds to the Owner in the full amount of the Contract price, covering both the faithful performance of the Contract and the payment of all obligations for labor and materials arising thereunder, on such forms as the Owner may prescribe and with such sureties as it may approve. Such bonds shall be duly executed by a qualified surety, conditioned upon the true and faithful performance of the Contract, and shall provide that if the Contractor or its subcontractors fail to duly pay for any labor, materials, or other supplies used or consumed by such Contractor or their subcontractors in the performance of the work contracted to be done, the surety will pay the same in an amount not exceeding the sum specified in the bond, as adjusted by approved change orders, and together with interest as provided by law. The Performance Bond shall additionally guarantee that the Contractor shall remedy any omissions, correct any and all defects, and adjust and make operable all component parts of the work falling under the requirements of its Contract, which may be called to its attention within a period of twelve (12) months following the date of the Letter of Acceptance.

27.2 The premium for all bonds shall be paid by the Contractor and included in the bid price in the Bid Proposal. The Owner will accept and approve bonds written by sureties legally authorized to write such bonds in the State of Colorado, provided such surety companies are rated in Best's Insurance Guide (latest edition), not lower that A- or have a Best's Financial Rating of at least X. If, at any time a surety on such a bond becomes irresponsible or loses its right to do business in the State of Colorado, the Owner may require another surety acceptable to the Owner, which the Contractor shall furnish within ten (10) days after receipt of written notice to do so.

27.3 Subcontractors, if solely pre-qualified by the Owner, prior to bidding, that enter into a subcontractor agreement with the Contractor for any portion of the work, shall provide the Contractor with Performance and Payment Bonds in accordance with the Contract Documents on the basis of their subcontract scope of work to the Contractor.

27.4 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

28.0 SUBCONTRACTS

28.1 The Contractor shall, within twenty-four (24) hours following the bid opening, provide to the Owner the entire list of subcontractors and suppliers of labor and materials whose quotations it has used in preparation of its bid. The Contractor shall, before awarding any subcontracts, re-verify to the Owner and Architect in writing on the standard form "Request for Approval of Subcontractors" the names of subcontractors proposed for the

project. Any deviation from the original subcontractor and supplier list will not be allowed unless justification is submitted in writing to the Owner by the Contractor that the subcontractor or supplier is deemed unfit or unable to perform the specified work, is unwilling to enter into a subcontract, or is not in compliance with the Contract Documents. The Contractor shall not employ any subcontractors that the Owner or Architect may, within a reasonable time, object to as incompetent, unfit, or otherwise undesirable. Substitutions of subcontractors listed in the executed proposal form may not be made without written approval of the Owner.

28.2 If, before or after the execution of the Contract, a change of any subcontractor on such list is required by the Architect or by the Owner prior to the award of the relevant contract, the contract sum may be increased or decreased by the difference in cost occasioned by such change and an appropriate change order shall be issued.

28.3 The Owner shall, on request, furnish to a subcontractor, wherever practicable, evidence of the amounts certified on its account. The Contractor agrees that it is as fully responsible to the Owner for the acts and omissions of its subcontractors and of persons either directly or indirectly employed by them, as it is for the acts and omissions of persons directly employed by it.

28.4 The Contractor, at the conclusion of the work and before final payment is made, shall furnish to the Owner a listing, giving names, contact persons, addresses, and telephone numbers of all subcontractors and material suppliers who furnished labor and materials on the project with identification of the services rendered and materials provided.

28.5 Nothing contained in the Contract Documents shall create any direct contractual relation between any subcontractor and the Owner.

29.0 RELATIONS OF CONTRACTOR AND SUBCONTRACTOR

29.1 The Contractor agrees to bind every subcontractor by a written agreement and require in its contracts that every subcontractor be bound by the terms of the Construction Agreement, the General Conditions of the Contract, the Supplementary General Conditions, the drawings and specifications as far as applicable to its work, including the following provisions of this Article, unless specifically noted to the contrary in a subcontract approved in writing as adequate by the Owner.

29.2 Each subcontractor shall agree with the Contractor:

29.2.1 To be bound to the Contractor by the terms of the Construction Agreement, General Conditions of the Contract, the Supplementary General Conditions, the drawings and specifications, and any other Contract Documents, and to assume toward him all the obligations and responsibilities that the Contractor, by those documents, assumes toward the Owner;

29.2.2 To preserve and protect the rights of the Owner and the Architect under the Contract with respect to the work to be performed under the subcontract so that the subcontracting thereof will not prejudice such rights;

29.2.3 To perform all work in accordance with the requirements of the Contract Documents;

29.2.4 To submit to the Contractor applications for payment in such reasonable time as to enable the Contractor to apply for payment as specified in the General Conditions;

29.2.5 To make all claims for changes in work, for extensions of time, and for damages for delays or otherwise, to the Contractor in the manner provided in the General Conditions of the Contract and the Supplementary General Conditions for like claims by the Contractor upon the Owner, except that the time for making claims for extra cost is one week.

29.2.6 To purchase and maintain for the duration of the project and the completion of the work and any warranty periods such insurance as required by Contractor in Article 26 of the General Conditions of the Contract.

29.3 The Contractor agrees:

29.3.1 To be bound to the subcontractor by all the obligations that the Owner assumes to the Contractor under the Agreement, General Conditions of the Contract, the Supplementary General Conditions, the drawings and specifications, and by all the provisions thereof affording remedies and redress to the Contractor from the Owner.

29.3.2 To pay the subcontractor not later than seven (7) calendar days immediately following the payment of each certificate issued under the schedule of values described in these General Conditions, the amount allowed to the Contractor on account of the subcontractor's work to the extent of the subcontractor's interest therein.

29.3.3 To pay the subcontractor, upon the payment of Certificates, if issued otherwise than as above, so that at all times the Contractor's total payments shall be as large in proportion to the value of the work done by it as the total amount certified to the Contractor is to the value of the work done by the subcontractor.

29.3.4 To pay the subcontractor to such extent as may be provided by the Contract Documents or the subcontract, if either of these provides for earlier or larger payments than the above.

29.3.5 To pay the subcontractor a just share of any insurance payment received by the Contractor, applicable to work performed by such subcontractor.

29.4 The Owner may require the Contractor to submit verified documentation evidencing that full and timely payments have been made to the subcontractors and suppliers and/or that legal justification exists for withholding payments. In addition, the Owner may contact the subcontractors and suppliers directly to obtain verification that payments have been made as required by law or the Contract Documents.

29.5 Nothing in this Article shall create any obligation on the part of the Owner to pay or to see to the payment of any sums to any subcontractor, nor shall it form the basis for any action by the subcontractor against the Owner on any contractual theories.

29.6 The Contractor shall arrange for the foreman of each subcontractor (mechanical, electrical, masonry, plastering, painting, etc.) on the job to meet with the Architect at the job prior to any work being started by this particular subcontractor so that all phases of the subcontractor's work can be thoroughly discussed and the quality of materials and workmanship expected can be completely understood and agreed upon.

30.0 ARCHITECT'S STATUS AND INSPECTIONS

30.1 Authority. The Architect shall be the Owner's representative during construction and until the expiration of the warranty period. The Architect shall have the authority to act on behalf of the Owner only to the extent expressly provided in the Contract Documents or

otherwise in writing. The Architect, with written approval of the Owner, shall have authority to stop the work whenever such stoppage may be necessary in its reasonable opinion to ensure the proper execution of the Contract.

30.2 Decisions. The Architect shall be, in the first instance, the interpreter of the conditions of the Contract and the judge of its performance, although the Owner shall retain the final authority in decisions regarding such matters. The Architect shall, within a reasonable time, make recommendations on all claims of the Contractor and on all other matters relating to the execution and progress of the work. All such decisions shall be subject to review by the Owner. The Architect's decisions in matters relating to artistic effect, after consultation with the Owner, shall be final, if within the terms of the Contract Documents.

30.3 Inspections. The Contractor shall provide timely notice to the Architect when inspections are desirable or required by the terms of the Contract Documents or the Architect's Agreement with the Owner and shall coordinate all inspections that are required by law as well as those inspections that the Owner contracts separately to be completed. Such notice also shall be given to the Owner's identified inspecting firm in order to allow for the following reviews and inspections, among others:

30.3.1 Reviewing and approving shop drawings samples and other submissions for conformance with the design concept of the project and for compliance with the information given in the Contract Documents;

30.3.2 Inspection of load-bearing surfaces or excavations before footings are poured;

30.3.3 Inspection of reinforcing steel after installation and before concrete is poured;

30.3.4 Inspection of structural and architectural concrete before, during, and after pouring;

30.3.5 Evaluation of all laboratory reports;

30.3.6 Inspection of structural steel after erection and prior to its being covered or enclosed;

30.3.7 Inspection of mechanical work following its installation and prior to its being covered and enclosed;

30.3.8 Inspection of electrical work following its installation and prior to its being covered or enclosed; and

30.3.9 Inspection of exposed surfaces for compliance with the Contract Documents.

31.0 CASH ALLOWANCES

The Contractor shall include in the Contract sum all allowances stated in the Contract Documents. These allowances shall cover the net cost of the materials and equipment delivered and unloaded at the site, and all applicable taxes. The Contractor's handling costs on the site, labor, installation costs, overhead, profit, and other expenses contemplated for the original allowance shall be included in the Contract sum and not in the allowance. The Contractor shall cause the work covered by these allowances to be performed for such amounts and by such persons as the Owner or Architect may direct, but the Contractor will not be required to employ persons against whom it makes a reasonable objection. If the cost, when determined, is more than or less than the allowance, the Contract sum shall be adjusted accordingly by change order which will include additional

handling costs on the site, labor, installation costs, overhead, profit, and other expenses resulting to the Contractor from any increase over the original allowance.

32.0 USE OF PREMISES

The Contractor shall confine its equipment, the storage of materials, and the operations of workers to limits indicated by law, ordinances, permits, and the Contract Documents and shall not unreasonably encumber the premises with its materials. The Contractor shall not load or permit any part of a structure to be loaded with a weight that will endanger the safety of persons or property. During the performance of the Work, the Contractor and his subcontractors and their employees, agents or suppliers, will use such entrance or entrances to the construction site that may be designated from time to time by the Owner. Further, the Contractor and its subcontractors, their employees and agents, shall perform the Work at such times of the day and days of the week as may be designated by the Owner from time to time. The Contractor shall enforce all Owner instructions and other regulations regarding signs, advertisements, fires, and smoking and shall not allow the possession or consumption of alcohol or drugs on the premises by its personnel or any subcontractor personnel.

33.0 CUTTING, PATCHING, AND EXCAVATING

33.1 The Contractor shall do all cutting, fitting, or patching of the work that may be required to make its several parts come together properly and fit it to receive or be received by work of the subcontractors shown upon, or reasonably implied by, the drawings and specifications for the completed project.

33.2 Any cost caused by defective or improperly timed work shall be borne by the party responsible therefor. The Contractor shall not endanger any work by cutting, excavating, or otherwise altering the work and shall not cut or alter the work of any subcontractor except with the consent of the Architect.

33.3 The Contractor and each subcontractor shall leave all chases, holes, or openings straight, true, and of proper size in its own work, or cut the same in existing work as may be necessary for the proper installation of its own or another contractor's or subcontractor's work, consulting with the Architect and the Contractor regarding proper location and size of same. In case of a failure to leave or cut same in the proper place, the Contractor or subcontractors shall cut them afterward at their own expense. No excessive cutting will be permitted, nor shall any piers or other structural members be cut or modified in the field without the written consent of the Architect. After such work has been installed, the Contractor and subcontractors shall carefully fit around, close up, repair, patch, and point up same as directed to the entire satisfaction of the Architect. Each section of the specifications shall include all cutting, patching, and excavating for that section unless specifically stated to the contrary.

34.0 CLEANING UP

34.1 The Contractor shall at all times keep the project site free from accumulations of waste material or rubbish caused by its employees or work, and shall remove all rubbish as often as is necessary or as directed by the Owner or the Architect. At the completion of the work, the Contractor shall remove all its rubbish from and about the building, and all its tools, scaffolding, and surplus materials and shall wash all glazing and window frames inside and outside throughout the building, removing all stains, paint, etc., from same. Care shall be taken not to scratch the glazing in this clean up.

34.2 All doors and wall coverings shall be left thoroughly clean and finished; all walls and ledges shall be dusted; all plumbing fixtures shall be cleaned; all hardware shall be free of all labels, paint, stains, dust, dirt, and the like; all marks, stains, fingerprints, other oil, and dirt shall be removed from painted, decorated, or natural finish work and the building will be ready for occupancy except for being further equipped by the Owner. In case of dispute, the Owner may perform such cleaning up as may be required and charge the cost to the Contractor.

35.0 SALES AND USE TAX

The Contractor shall coordinate with the Owner to ascertain whether a sales or use tax may be collectible on the purchase of building materials, supplies, and equipment used for this project by the Contractor. Some cities and municipalities will charge a sales or use tax on building materials, supplies, and equipment "picked up" and/or used within that city or municipality by a contractor. Whenever possible, the Contractor shall have building materials, supplies, and equipment for this project delivered to the construction site by common carrier, conveyance by the seller, or by mail to avoid city or municipal sales and use taxes for which refunds will not be made. The Owner is typically exempt from the payment of any State sales and State use taxes for materials, supplies, and equipment used upon this project by the Contractor and subcontractors. For the purpose of exercising such exemption, the Contractor and all their subcontractors shall apply for and obtain a Certificate of Exemption for the work from the Colorado Department of Revenue. A copy of such Certificates shall be filed with the Owner before any materials are purchased or any work commenced hereunder.

36.0 APPROVAL OF SUBSTITUTIONS

36.1 The Contractor will be held to have used in its base proposal and to furnish under the Contract those items of equipment and/or materials which are specifically identified in the specifications by a manufacturer's name, model, or catalog number. Items of equipment of the Contractor's choice may be offered as alternates to the items named in the specifications by submitting with the proposal and on the form provided, identifying data on the articles proposed, together with a statement of the amount of addition or deduction from the base bid if the bidder's alternate is accepted. Prior approval by the Architect is not required on items submitted as alternate bids. After execution of the Construction Agreement, substitution of equipment and/or materials of makes other than those specifically named in the Contract Documents may be approved by the Owner so long as the equipment or material proposed for substitution in the opinion of the Owner and the Architect is just as suitable as equipment and/or materials named in the specifications so far as performance, construction, efficiency, and utility are concerned. A request for substitution shall be required to be based upon one or more of the following grounds for justification: the submitted material is no longer available, a substitution will improve lead time, quality will be improved (documented detail required), or the Owner will incur substantial savings. All requests for substitution must be submitted in writing with supporting documentation by or through the Contractor to the Architect for initial review, before being submitted to the Owner for evaluation and final approval. In the absence of the Owner's written approval, no substitution of materials or methods will be allowed for any items specified in the Contract Documents.

36.2 In case of a difference in price, occurring as a result of an approved substitution, the Owner shall receive all benefit of the difference in cost involved in the substitution. All

approved substitutions will be documented by the issuance of a formal change order as provided in these General Conditions.

37.0 OCCUPANCY

The Contractor, upon the Owner's written request, shall allow the Owner to occupy portions of the work and to place and install, subject to reasonable restrictions, as much equipment and furnishings during the progress of the work as is possible without interfering with the progress of the work. Such occupancy and the placing or installing of equipment and furnishings shall not in any way evidence the completion of the work or signify the Owner's acceptance of the work, or any part of it. Equipment includes such things as kitchen equipment, etc. Furnishings include such things as lockers, benches, desks, etc. Prior to occupancy, when practicable, the Architect shall make a thorough inspection accompanied by the Contractor's superintendent to note any defects in workmanship or materials, which are the responsibility of the Contractor. The provisions of the Article shall not be in limitation of the Owner's rights set forth in GC 18, claims for extra cost or additional time, herein.

38.0 DAMAGE TO UTILITIES

38.1 The Contractor shall take adequate precautions to protect existing utilities on and off the site and avoid damage thereto. The Contractor shall repair or replace or have repaired or replaced at its own expense any damage to streets, water, sewer, light, power, cable, or telephone lines or fiber network damaged by reason of its work.

38.2 The location and extent of underground utilities and cables and conduit as indicated on the drawings are not guaranteed. This information is shown only for such use as bidders and Contractors may choose to make of it. All Contractors shall check with all public utilities companies for locations and shall comply with their regulations regarding their utilities in performing the work.

38.3 Active underground utilities shall be adequately protected from damage and if damaged shall be immediately repaired. Removal or relocation of same shall be done only as indicated on the drawings. If they are in use, they shall be maintained in continuous service. If not indicated on the drawings or not known to exist, the Contractor shall report discovery of such lines to the Architect and shall not proceed further until directed to do so.

38.4 Inactive or abandoned utilities, whether or not they are indicated on the drawings, shall be recorded as to location and depth and shall be removed for a distance of not less that three (3) feet from outside line of all concrete work unless otherwise required by regulations. Ends shall be capped or plugged. There will be no adjustment of Contract amount for work due to inactive or abandoned utilities.

39.0 PROJECT SIGN

If required by the specifications, the Contractor shall provide a project sign. Unless approved in advance by the Owner no other advertising is permitted on the project site.

40.0 BLASTING

No explosives of any nature except for those normally employed in powder actuated tools, .38 caliber or smaller, shall be employed or used on any site except with the express and specific prior written approval of the Architect and the Owner and any appropriate governmental authorities,

in each instance. The Contractor shall notify the Architect of need for such approval three (3) days prior to the proposed use of such explosives.

41.0 HISTORICAL DATA

In addition to warranties, guarantees, operating instructions, etc., elsewhere specified, the Contractor, at the conclusion of the work and before final payment is made, shall furnish a listing, giving principal's names, addresses, and telephone numbers of all subcontractors and material suppliers who furnished labor or materials on the job with identification of the services rendered. There shall be provided one (1) electronic copy for the Architect and two (2) paper copies for the Owner. All copies shall be delivered to the Architect for review and distribution.

42.0 COMMISSIONING AND TESTING OF BUILDING SYSTEMS

Consistent with the Contract Documents and the applicable codes, the Contractor shall submit a written plan prior to completion and acceptance for the commissioning and testing of all building systems. All testing shall be of the complete system, before covering, or of individually separable larger portions of the system and shall be performed in the presence of the appropriate authority having jurisdiction, the consultant, and representative of the Owner. As part of the Operating and Maintenance submittals, a written report shall be filed in the office of Design and Construction Management, Jefferson County School District No. R-1, recording each test, and signed by the consultant.

43.0 TEMPORARY OR TRIAL USAGE

43.1 Temporary or trial usage by the Owner of any mechanical device, machinery, apparatus, equipment, or any work or material supplied under the Contract before final completion and written acceptance by the Architect shall not be construed as evidence of the Architect's or Owner's acceptance of same or the commencement of any warranty periods.

43.2 The Owner has the privilege of such temporary or trial usage, for such reasonable time as the Owner and the Architect deem proper. The Contractor shall make no claim for damage or injury to or breaking of any parts of such work, which may be caused by weakness or inaccuracy of structural parts or by defective materials or workmanship. If the Contractor so elects, they may, without cost to the Owner, make such trial usage. However, trials shall only be conducted with the Architect's prior approval and under their observation.

43.3 When heating, air conditioning, ventilating, exhaust, or other items of electrical or other equipment are installed, it shall be the responsibility of the Contractor installing such equipment to operate it for a satisfactory period of time as required by the Architect for proper testing of the equipment and instructing the Owner's operating personnel. All items of equipment, testing meters, testing instruments, and incidentals required for proper testing and for instructing the Owner's operating personnel, shall be provided by the Contractor responsible for providing and installing the equipment.

44.0 ASSIGNMENT

The Contractor shall not assign its interests herein in whole or in part without the written consent of the Owner; nor shall the Contractor assign any moneys due or to become due to him hereunder, without the previous written consent of the Owner.

45.0 SEPARATE CONTRACTS

45.1 The Owner reserves the right to let other contracts in connection with this work. The Contractor shall afford such other contractors reasonable opportunity for the introduction and storage of their materials and the execution of their work. The Contractor shall properly connect and coordinate its work with the work of other contractors.

45.2 If any part of the Contractor's work depends for proper execution or results upon the work of any other contractor, the Contractor shall inspect and promptly report to the Owner through the Architect any defects in such work that render it unsuitable for such proper execution and results. The Contractor's failure to inspect and report shall constitute an acceptance of the other contractor's work as fit and proper for the reception of its work, except as to defects that may subsequently develop in the other contractor's work.

45.3 To ensure the proper execution of its subsequent work, the Contractor shall measure work already in place and shall at once report to the Owner through the Architect any discrepancy between the executed work and the Contract Documents.

46.0 CONTRACTORS' MUTUAL RESPONSIBILITY

The entire project may be covered by more than one contract and in such case there will of necessity be a certain overlapping of contracts. Each contractor shall, therefore, take due notice of the work called for in contracts other than its own. Should the Contractor cause damage to any separate contractor on the work, the Contractor agrees, upon due notice, to settle with such other separate contractor by agreement, if it will so settle. If such other separate contractor sues the Owner on account of any damage alleged to have been so sustained, the Owner may notify the Contractor, who shall, at the Owner's option, defend such proceedings at the Contractor's expense or reimburse the Owner for the expenses incurred in defense, and, if any judgment against the Owner arises therefrom, the Contractor shall pay or satisfy it and pay all costs and expenses thereby incurred by the Owner.

47.0 LIENS

It is hereby mutually understood by and between the parties hereto that no Contractor, subcontractor, supplier, vendor, laborer, mechanic, or other person, can or will contract for or in any other manner have or acquire any lien upon the building or works covered by this Contract, or the land upon which the same is situated. It is the Contractor’s responsibility to notify all subcontractors, vendors, laborers, mechanics, or other persons of this contract provision. The Contractor will be responsible for any and all costs incurred by the Owner having to address any liens.

48.0 WORK IN EXISTING BUILDING

48.1 In addition to all other requirements of the Contract Documents, if the work involves an addition or alteration to an existing building, the Contractor shall erect and maintain during the progress of the work, suitable dustproof partitions to protect such building and the occupants thereof. If necessary, in the Owner's or Contractor's judgment or pursuant to manufacturer's directives or recommendations in order to protect occupants from noxious fumes, odors, or hazardous substances, the Contractor may be required to provide additional ventilation and/or work different or extended hours to avoid disruption to other activities within the existing building. Contractor shall protect and keep from harm all occupants of an

existing building from construction activities, and shall include a safe pathway into and out of the school.

48.2 If any portions of an existing building are to be remodeled or repaired, such portions shall be adequately partitioned off with dustproof partitions and well ventilated. All remodeling work shall be scheduled and submitted to the Owner and Architect for approval. The various contractors shall schedule their work jointly, in order that each may accomplish their work within such existing building in an orderly fashion during regular school vacation periods, where possible, or in such a manner as to permit full use of the building and without impairment of any existing facilities.

48.3 Existing building systems, such as fire alarm, temperature controls and air distribution, security systems, public announcement systems, irrigation systems, and the like, shall be demonstrated and noted by Owner to the Contractor as operational prior to Contractor's commencing the Work and Contractor may participate in observation of such systems. Such systems are the responsibility of the Contractor to maintain in pre-construction condition.

49.0 INDEMNIFICATION

49.1 Indemnification. To the fullest extent permitted by law, the Contractor shall indemnify, hold harmless and, not excluding the Owner's right to participate, defend Owner its subsidiary, parent, associated and/or affiliated entities, successors, or assigns, its elected officials, trustees, employees, agents, volunteers, and any jurisdiction or agency issuing permits for any work included in the project, hereinafter referred to as indemnitee, from ALL suits and claims, including attorney's fees and cost of litigation, actions, loss, damage, expense, cost or claims of any character or any nature arising out of the work done in fulfillment of the terms of this Contract or on account of any act, claim or amount arising or recovered under workers' compensation law or arising out of the failure of the Contractor to conform to any statutes, ordinances, regulation, law or court decree. It is agreed that the Contractor will be responsible for primary loss investigation, defense and judgment costs where this contract of indemnity applies. In consideration of the award of this contract, the Contractor agrees to waive all rights of subrogation against the Owner, its subsidiary, parent, associated and/or affiliated entities, successors or assigns, its elected officials, trustees, employees, agenda, and volunteers for losses arising from the work performed by the Contractor for the Owner. The indemnification requirement and obligation shall extend beyond and be separate from any specified insurance liability limits contained in this agreement. This specific indemnification by the Contractor is in addition to and not in lieu of other remedies, which may be available to the Owner. This provision shall survive the termination of the contract

49.2 The obligations of the Contractor under this Article shall not extend to and will be reduced by the liability of the Architect or the Architect's Consultants to the extent directly attributable to and proximately caused by (A) the negligent preparation or approval of drawings or specifications, or (B) errors or omissions in written directions or instructions given by the Architect or the Architect's Consultants.

50.0 LIQUIDATED DAMAGES FOR DELAY IN COMPLETION

It is understood and agreed that completion of the entire Project within the time specified in the Construction Agreement is a matter of vital necessity to the Owner, that the Owner will suffer

substantial damages if the entire project is not completed within the specified time, and that it would not be possible to accurately determine the amount of such damages. In view of these facts, the Contractor agrees to pay the Owner liquidated damages in the sum set forth in the Construction Agreement for each calendar day, if any, which elapses between the date stated in the Construction Agreement, as extended by any extensions of time under the provisions of these General Conditions of the Contract, and the date of final completion when the entire Project is finally accepted within the meaning of the acceptance and final payment provision of these General Conditions of the Contract. If the Contractor fails to pay such liquidated damages promptly upon demand therefor, the surety on the Contractor's performance bond shall pay such damages. Also, the Owner may withhold all or any part of such liquidated damages from any payment due the Contractor. No changes in the Work shall extend the time for completion or the contract schedule unless set forth in a properly approved change order.

51.0 ACCEPTANCE AND FINAL PAYMENT

51.1 Within fifteen (15) days of written notice from the Contractor of final completion of the work and before final acceptance thereof, a final inspection shall be made by the Architect accompanied by the Owner to determine whether the work has been completed in accordance with the Contract Documents. A written Report of Inspection and detailed "punch list," certified as to contents and date of inspection, shall be completed by the Owner and the Architect and delivered or mailed to the Contractor.

51.2 All prior Requests for Payment shall be subject to correction in the final Request for Payment. When all work, including the punch list, has been certified by the Architect as finally and satisfactorily completed, and approved by the authorized representative of the Owner, it shall be deemed accepted as of the date of the issuance of the Owner's Letter of Acceptance.

51.3 Upon submission of the final Request for Payment, the time of final settlement for the work shall be established and shall, thereafter, be advertised by two (2) publications of notice, the last of which shall appear at least ten (10) days prior to the time of final settlement. Final payment and settlement shall be made at the time of final settlement as advertised, or as soon thereafter as appropriate and practicable, in the judgment of the Owner. The Owner shall not authorize final payment until all items on the final punch list are complete, all operations and maintenance manuals accepted, all Owner training is complete, and all as-built and close out documents are filed with the Owner.

51.4 If any unpaid claim for labor, materials, supplies, or equipment is filed with the Owner before payment in full of all sums due the Contractor, the Owner shall withhold from the final payment sufficient funds, if available, to provide for the payment of such claim, until the same shall have been paid or withdrawn. Such payment or withdrawal shall be evidenced by filing with the Owner a receipt in full or an order authorizing withdrawal signed by the claimant or their duly authorized agent or assignee. Such funds shall ordinarily not be withheld longer than ninety (90) days following the date fixed for final settlement with the Contractor, as set forth in the published Notice of Contractor's Settlement, unless an action has been commenced within that time to enforce such unpaid claim and a Notice of Lis Pendens has been filed with the Owner. At the expiration of the ninety (90) day period, the Owner shall release to the Contractor all funds that are not the subject of such action. Notwithstanding the provisions in this section, in the event the Colorado statutory procedure as set forth herein is amended during the term of the Construction Agreement, such amended procedure shall be substituted accordingly.

51.5 If any claim for such labor, materials, supplies, or equipment remains unsatisfied after all payments are made by the Owner to the Contractor, the Contractor shall refund to the Owner all sums which the latter may for any reason be compelled to pay to satisfy such claim, including all costs and attorneys' fees incurred by the Owner as a result of the Contractor's default in such respect.

51.6 The making and acceptance of the final payment shall not constitute a waiver of any claims by the Owner, including, among other things, those arising from unpaid claims, from faulty work, which appears before or after final payment, or from any failure to comply with any requirements of the Contract Documents.

51.7 The Contractor, at the conclusion of the work and before final payment is made, shall furnish a listing, giving names, addresses, and telephone numbers of all subcontractors and material suppliers who furnished labor or materials on the project with identification of the services rendered or materials provided.

51.8 The Contractor, at the conclusion of the work and before final payment is made, shall furnish to the Owner a list itemizing all kitchen equipment, with associated costs, that was installed in the project.

52.0 WARRANTIES ON PORTIONS OF THE WORK

The Contractor shall, in case of work performed or materials or equipment provided for which warranties are required by the Contract Documents, secure the required warranties and deliver copies thereof to the Architect and the Owner upon completion of the work. All such warranties shall commence from the date set forth in the Letter of Acceptance and will not in any way reduce the Contractor's responsibilities under the Contract. Whenever guarantees or warranties are required by the specifications for a longer period than one year, such longer period shall govern.

53.0 CONTRACTOR'S PROJECT GUARANTEE AFTER COMPLETION

53.1 The Contractor expressly warrants and guarantees that the project will be constructed in a first-class, workmanlike manner; that it will be safe, free from structural and workmanship defects and defects in materials; and that the improvements will be suitable and fit for occupancy and for the purpose for which they were intended.

53.2 Neither the Architect's approval of the final Request for Payment nor payment of any Request for Payment or of any sum previously withheld from the Contractor shall relieve the Contractor of responsibility for the warranty and guarantee hereunder or for faulty materials or workmanship, and, unless otherwise agreed, they unconditionally agrees to remedy any defects due thereto, and pay for any damages resulting therefrom, which shall appear within a period of one (1) year from the date set forth in the Letter of Acceptance of its work.

53.3 After the work has been accepted by the Architect and the Owner, the Owner, the Architect, and the Contractor together shall make one (1) complete inspection of the work. The inspection shall be made approximately eleven (11) months after the final acceptance of the work. The Architect shall make a written report of the inspection, certified as to contents and date of inspection, and forward the report by mail to the Owner and the Contractor within seven (7) days after completion of the inspection. The Contractor shall immediately initiate such remedial work as may be necessary to correct any deficiencies or defective work shown by this report, and shall complete all such remedial work within 30 calendar days in a manner acceptable to the Owner.

53.4 If the Contractor fails to promptly correct all deficiencies and defects shown by the report, the Owner may do so, after giving the Contractor ten (10) days' written notice of intention to do so. The Owner shall be entitled to collect from the Contractor all costs and expenses incurred in correcting such deficiencies and defects, as well as all damages resulting from such deficiencies and defects. The guarantee and warranties of the Contractor provided for herein are in addition to and not in lieu of any other remedies available to the Owner.

54.0 LIMITATION OF ACTIONS AND VENUE

54.1 Any actions against the Contractor, its subcontractors, suppliers, or others providing materials or services for the project, brought to recover damages for injury to person, damage to property, including loss or damage to the property or the project itself, or defects in materials caused by the design, manufacture, supplying, planning, supervision, inspection, construction, or observation of construction of the project shall be brought within six (6) years after such claim for relief arises and the nature and extent are fully discovered.

54.2 In no case shall such an action be brought more than ten (10) years after the final completion and acceptance of the project; provided, however, that in any case where the cause of action arises during the tenth year, such action shall be brought within six (6) years after such cause of action arises and the nature and extent are fully discovered by the Owner.

55.0 SOIL TEST REPORT

The Owner may arrange for a separate consultant to conduct field and laboratory soil investigations on the site and to prepare a report of the findings. Such reports, if accomplished, will be bound into the specifications and contract documents. The data contained in any such document prepared for the Owner by a separate consultant is believed to be reliable; however, the Owner and Architect do not guarantee its completeness. All applicable subcontractors shall be fully familiar with the contents of such reports, if prepared, and shall consider and evaluate them in the performance of their contracts.

56.0 EXPEDITING MATERIALS

The Contractor shall, immediately after receipt of Notice of Contract Award and approval of its list of subcontractors, material suppliers, and required shop drawings, place orders for all equipment, materials, and supplies required for the work. The Contractor shall, when requested, submit to the Owner evidence that such orders have been placed. The Contractor shall exercise due diligence in seeing that all equipment, materials, and supplies are delivered well in advance of the time they are needed on the project; and shall properly store and protect same at its expense and in accordance with these General Conditions, either at the project site or elsewhere as approved by the Architect.

57.0 MISCELLANEOUS KEYS, SWITCHES, ETC.

Except as otherwise specifically required by the Project Technical Specifications at the completion of the project, all loose keys for hose bibs, adjustment keys and wrenches for door closers and panic hardware, keys for electric switches, electrical panels, and all other equipment shall be identified and accounted for and turned over to the Architect for transmittal to the Owner.

58.0 PREFERENCE FOR COLORADO LABOR, MATERIALS, AND RESIDENT BIDDERS

58.1 In compliance with Colorado Revised Statutes §§ 8-17-101 and 8-17-102, Colorado labor shall be employed to perform at least eighty percent (80%) of the Work. Owner, in Owner's sole discretion after consultation with the State of Colorado, shall have the right to waive the eighty percent requirement if, in the Owner's sole discretion, there is reasonable evidence to demonstrate insufficient Colorado labor to perform the Work and if compliance with this Section 53.01 would create an undue burden that would substantially prevent a project from proceeding to completion. Owner shall not impose contractual damages on Contractor for a delay in the Work due to the Owner's decision to exercise this right. The term "Colorado labor" means any person who is a resident of the state of Colorado, at the time of the public works project, without discrimination as to race, color, creed, sex, sexual orientation, national origin, ancestry, age, or religion except when sex or age is a bona fide occupational qualification. A resident of the state of Colorado is a person who can provide a valid Colorado driver's license, a valid Colorado state-issued photo identification, or documentation that he or she has resided in Colorado for the last thirty days.

58.2 In compliance with C. R.S § 8-18-101, if any of the work includes a contract for commodities and services, preference shall be given to a resident bidder (as defined in GC 59.3) against a nonresident bidder equal to the preference given or required by the state in which the nonresident bidder is a resident.

58.3 In compliance with C. R.S §§ 8-19-101 and -102 , preference shall be given to resident bidders against nonresident bidders from a state or foreign country equal to the preference given or required by the state or foreign country in which the nonresident bidder is a resident. The term "resident bidder" means a person, partnership, corporation, or joint venture which is (a) authorized to transact business in Colorado and which maintains its principal place of business in Colorado; or (b) authorized to transact business in Colorado, which maintains a place of business in Colorado, and which has paid Colorado unemployment compensation taxes in at least six (6) of the eight (8) quarters immediately prior to bidding on the work.

59.0 LABOR DISPUTES

59.1 Notwithstanding any other provision contained elsewhere herein and superseding any contrary term expressed herein, the Contractor agrees that in the event of any picket or other form of labor dispute at the construction site, whether such dispute or picket is in connection with the Contractor, subcontractor, or any other person or entity on the construction site, the Contractor will continue to perform the work required herein without interruption or delay. In the event the Contractor fails to continue the performance of the work included herein, without interruption or delay, because of such picket or other form of labor dispute, the Owner may terminate the services of the Contractor after giving seventy-two (72) hours' written notice of intent to do so. The terminated Contractor may then be replaced at the discretion of the Owner and all extra costs involved in doing so shall be payable by the terminated Contractor.

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4837-1075-2300, v. 1

Project # F04600A01 / ITB # 26511

Bergen Valley Elementary School Addition & Renovation

ADDENDUM #1

Today's date: August 7, 2023

ITB Close Date: August 31, 2023 at 2:00 p.m.

ITB to be submitted prior to the time and date above

The modifications and clarifications are hereby incorporated into the Bid document. All other information remains unchanged.

As noted at the August 7th,2023 site, the following changes will be made to the Bid timeline:

- Question deadline is now August 14th, 2023 at 2:00 PM
- Addendum will be issued by August 18, 2023 at 4:00 PM

All other dates in the Bid timeline remain the same.

For Questions, please also e-mail Amy Hollopeter at Amy.Hollopeter@Jeffco.k12.co.us by the August 14th deadline as she will handle all questions in my absence.

Addendum 02

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01:

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	
DATE OF ISSUANCE:	08/18/2023

This Addendum is issued to modify, explain, or correct the original drawings and project manual and is hereby made a part of the Contract Documents. Please attach this Addendum to the specifications in your possession.

Each bidder shall carefully read all items in their entirety and thoroughly examine the Contract Documents to determine to what extent various clarifications, changes, and conditions will affect their bid.

I. PRECONSTRUCTION RFIs

See attached responses.

II. PROJECT MANUAL

SPECIFICATIONS

SECTION 01 21 00 – Allowances
REMOVE allowance 02 from scope.

SECTION 01 23 01 – Alternates
ADD new alternate 03: Accelerated Construction Schedule

Base bid: construction schedule - GC to commence construction 10/23 with substantial completion 12/1/2024.

Alternate: in lieu of base bid, construction schedule - GC to commence construction 10/23 with substantial completion 8/1/2024.

SECTION 08 62 23 – Tubular Skylights
Add spec section.

SECTION 31 00 00 - Earthwork
Relace spec section in its entirety

SECTION 31 25 00 - Erosion and Sediment Control
Relace spec section in its entirety

SECTION 32 12 00 – Flexible Paving
Relace spec section in its entirety

SECTION 32 13 00 – Rigid Paving
Relace spec section in its entirety

SECTION 33 10 00 – Water Utilities
Relace spec section in its entirety

SECTION 33 33 00 – Sanitary Sewerage Utilities
Relace spec section in its entirety

III. CONSTRUCTION DOCUMENTS

GENERAL Sheets (G)

G000 INDEX
ADD sheet A514

ARCHITECTURAL DEMOLITION Sheets (AD)

AD101 1st FLR DEMOLITION PLAN – OVERALL
ADD keynote 0241-13 in room 171 LMC

AD111 1st FLR CEILING DEMOLITION PLAN – OVERALL
ADD keynote 0241-14 in room 171 LMC

ARCHITECTURAL Sheets (A)

A101C 1ST FLR PLAN – AREA C
REVISE rooms 127, 127A & 127B.
ADD detail E1/A521.

A111A 1ST FLR CEILING PLAN – AREA A
REVISE ceiling plan to add tubular skylights in room 178

A111C 1ST FLR CEILING PLAN – AREA C
REVISE ceiling plan to add tubular skylights in room 122.
REVISE ceiling plan in rooms 127, 127A & 127B.

A120 1ST FLR PLAN – FINISHES
REVISED floor finish hatch and tag to concrete in room 122B & 125
ADD tile to drinking fountain in corridor CR109

A140 1ST FLR CEILING PLAN – AREA C
ADD tubular skylights as noted.

A201 EXTERIOR ELEVATIONS
ADD detail callouts to elevation D4.

A232 INTERIOR ELEVATIONS
ADD note: Tile base with dilex trim to elevation C1

A510 EXTERIOR SECTION DETAILS
REVISE details A4 & C5 fascia/flashing detail.

A514 EXTERIOR SECTION DETAILS
ADD new sheet.

PLUMBING Sheets (P

P100C UNDERGROUND PLUMBING PLAN – AREA C
Underground sanitary and storm piping REVISED for new staff restroom layout

P101C 1ST FLR PLUMBING PLAN – AREA C
Floor plan REVISED for new staff restroom layout
Storm piping drop REVISED for new staff restroom layout.

P301 ENLARGED PLUMBING PLANS & ISOMETRICS
Enlarged plans piping layouts REVISED for new staff restroom layout.
P401 PLUMBING ISOMETRICS
San/Vent and Domestic Water isometrics REVISED for piping revisions for the new staff restroom layouts

MECHANICAL Sheets (M)

M001 MECHANICAL CODE SHEET
ADD 2023 NEC to our code references

M101C 1st FLOOR MECHANICAL PLAN – AREA C
With direction from the acoustic consultant, REVISE “L” transfers to “Z” type transfers
With direction from the acoustic consultant, REVISE ductwork downstream of the VAV boxes so that there is 15’ before the first takeoff.
With direction from the acoustic consultant, REVISE all EF-12 exhaust duct out of classroom 122
With direction from the acoustic consultant, REVISE all EF-11 exhaust duct out of classroom 129

M140 MECHANICAL ROOF PLAN – OVERALL
EF-12 REVISED so its duct does not drop inside a classroom.

ELECTRICAL Sheets (E)

E101A ELECTRICAL 1ST FLOOR POWER PLAN – AREA A
ADD – Power for TDD dimmers in Classroom 178.
ADD – Keynote #9.

E101C ELECTRICAL 1ST FLOOR POWER PLAN – AREA C
REVISE – Staff Toilet 127A and STOR 127B. Adjust power and fire alarm device layout to match new room locations.
ADD – convenience receptacle in STOR 122B.
ADD – Power for TDD dimmers in Classroom 124.
ADD – Keynote #6.

E201A ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA A
REVISE - Classroom 178 lighting layout. Lighting fixtures changed to existing to be relocated ("(RL)").
ADD – Classroom 178. Add (4) daylight zones, (1) photocell, and controls.
DELETE – Classroom 178. Remove hatch.

E201C ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA C
ADD - Classroom 124. Add (4) daylight zones, (1) photocell.
REVISE – Classroom 124. Change Sequence of Operations from VD1 to VP1.

REVISE – Classroom 117, 119, 120, 123, 124, 129, 131, and 134. Change lighting device from type RDW1 to type RDW2.
REVISE – Staff Toilet 127A and STOR 127B. Adjust lighting and controls layout to match new room locations.

E710 ELECTRICAL PANEL SCHEDULES
ADD – (2) circuits for TDD dimmers in Panel L1E.

E801 ELECTRICAL LIGHTING CONTROLS SCHEDULES
ADD – Type RDW2 to Lighting Controls Device Schedule.
ADD – Keypad general notes.

TECHNOLOGY Sheets (T)

T101C TECHNOLOGY 1ST FLOOR PLAN – AREA C
ADD – (2) data outlets in Teach Plan 128.

T201C TECHNOLOGY 1ST CEILING PLAN – AREA C
REVISE – Teach Plan 128. Adjust WAP location to match adjusted floor plan.

END OF ADDENDUM

Addendum 03

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01:

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	
DATE OF ISSUANCE:	08/23/2023

This Addendum is issued to modify, explain, or correct the original drawings and project manual and is hereby made a part of the Contract Documents. Please attach this Addendum to the specifications in your possession.

Each bidder shall carefully read all items in their entirety and thoroughly examine the Contract Documents to determine what extent various clarifications, changes, and conditions will affect their bid.

I. PROJECT MANUAL

SPECIFICATIONS

SECTION 01 23 01 – Alternates
ADD new **ADDITIVE** alternate 03: Accelerated Construction Schedule

> Base bid: construction schedule - GC to commence construction 10/23**/2023** with substantial completion 12/1/2024.
>
> **ADDITIVE** Alternate: in lieu of base bid construction schedule - GC to commence construction 10/23**/2023** with substantial completion 8/1/2024.
>
> **Alternate 03 amount should only include additional costs as necessary to accelerate the schedule to meet the 8/1/2024 substantial completion date.**

SECTION 31 00 00 – Earthwork
Blasting information added per the latest Geotech report.

SECTION 09 21 16 Gypsum Board Assemblies
REVISE paragraph 2.03.B.1 as follows:

1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated. **Mold-resistance board is required whenever board is being installed before the building is enclosed and conditioned, and at first floor locations to four feet above finish floor.**

SECTION 09 21 16 Gypsum Board Assemblies
ADD paragraph 2.03.B.6 as follows:

6. Mold Resistant Paper Faced Products:

- **a. CertainTeed Corporation; ProRoc Moisture and Mold Resistant.**
- **b. Georgia-Pacific Gypsum; ToughRock Mold-Guard.**
- **c. National Gypsum Company; Gold Bond XP.**
- **d. USG Corporation; Sheetrock Brand Mold Tough.**

SECTION 12 93 00 SITE FURNISHINGS
DELETE: Player's Bench removed from specification.

SECTION 32 84 00 IRRIGATION
ADD: Hunter I-20 Series added to approved products.
ADD: Root Watering System.

SECTION 32 91 13 FINE GRADING AND SOIL PREPARATION
ADD: Topdressing and overseeding sections added.

SECTION 32 92 19 SEEDING
ADD: Turf grass seed mix added.

SECTION 32 93 13 INERT GROUND COVER MATERIALS
DELETE: Infield mix removed.

II. CONSTRUCTION DOCUMENTS

CIVIL Sheets (C)

C0.2 Demolition Plan
Plans updated to reflect the removal of the baseball field

CE1.0 Erosion Control Plan
Removed field grading and removed inlet

C1.0 Overall Grading and Drainage Plan
Revised overall grading and drainage plan to remove field elements

C1.1 Detailed Grading and Drainage Plan
Removed grading for field area
Revised grading

C1.2 Detailed Grading and Drainage Plan
Added grading for detention pond area.
Added trickle channel
Added outlet structure
Added outfall pipe and flared end section
Added spillway

C1.3 Detailed Grading and Drainage Plan
Added invert information to proposed storm infrastructure.
Deleted storm inlet and storm pipe
Revised double valley inlet to triple valley inlet
Deleted grading for field area
Revised grading for added ADA walk

C1.4 Detailed Grading and Drainage Plan
Deleted grading for field area.

CD1.0 Grading and Drainage Details
Plans updated to show the updated spillway design

CD1.1 Grading and Drainage Details
Plans updated to show the updated outlet structure

C3.0 Overall Horizontal Conrol Plan
Revised to show deleted field and added walk

C3.1 Detailed Horizontal Control Plan
Revised walk

C3.2 Detailed Horizontal Control Plan
Plans updated to show the updated detention pond design

C3.3 Detailed Horizontal Control Plan
Revised walk

C3.4 Detailed Horizontal Control Plan
Revised to show deleted field and added walk

CD3.0 Horizontal Control Details
Revised heavy duty asphalt pavement section.

LANDSCAPE/IRRIGATION Sheets (L OR LI)

L2.0 OVERALL SITE PLAN
DELETE: Backstop, softball infield, and new outfield fencing removed.
ADD: Turf Topdress and Overseed hatch in plan and legend.

L3.0 FIELD ENLARGEMENT
DELETE: Backstop, softball infield, and new outfield fencing removed.
ADD: Turf Topdress and Overseed hatch in plan and legend.

L4.1 SITE DETAILS
DELETE: Softball Backstop Footing and Softball Backstop details removed.

LI1.0 OVERALL IRRIGATION PLAN
ADD: Relocate and replace existing valve one (1) outside of the new ECE play pit and into the existing sod bed near the playground access doors. Cap laterals north of the new sidewalk connecting the existing play pad with the building addition.

ADD: Relocate existing mainline to be outside of new ECE play pit. Sleeve mainline under concrete.

ADD: Abandon existing station 2. Reuse wires.

ADD: All irrigation South-East slope (below the existing play pad) is to remain so not to disturb existing trees.

ADD: Replace all existing irrigation within the playfield with new 100% spray coverage.

ADD: Replace all existing irrigation in a new sod area around new drainage inlet and new sidewalk.

ADD: Replace all existing irrigation in the previous ball field with new 50% spray coverage.

ADD: Relocate existing valve nine (9) to be outside of new cobble. Cap lateral to tree to be removed.

ADD: Replace existing irrigation in planting/sod beds in the front of the school building that have new grading (re: civil)

ADD: Install all new valves. Install new irrigation in all landscape areas that have been renovated and added in the project.

ADD: Replace all irrigation around new ADA access sidewalk to field. Irrigate all new sod with 100% spray coverage with minimum sidewalk overspray.

ADD: Hunter I-20 Series added to approved products.

ADD: Connect new shade trees around the new ECE play area to the existing root watering system.

STRUCTURAL Sheets (S)

S101C FOUNDATION PLAN - AREA C
REVISE pilasters at grids 4.8, 9.8/B1
REVISE footing at grids 4.8/B1
ADD wall opening detail at grids 7.4/F1
REVISE columns at grids 7.8/D1 and 3/G1
REVISE detail along grid 3.7
REVISE keynote 04

S102C ROOF PLAN - AREA C
REVISE roof framing and connections throughout where clouded
ADD skylights and supporting framing

ADD details throughout where clouded
ADD dimensions throughout where clouded
ADD snow drift 3
REVISE snow drift 1
ADD keynotes 07 – 10

S301 CONCRETE DETAILS
REVISE details 1, 2, and 11

S302 CONCRETE DETAILS
REVISE details 1, 2, 7, and 12

S303 CONCRETE DETAILS
REVISE detail 14

S501 STEEL DETAILS
REVISE details 1, 3, 6, 8, and 11

S502 STEEL DETAILS
REVISE details 1, 2, 3, 4, 8, 11, 14, 15, and 17,
ADD details 16, 18, 19, and 20

S503 STEEL DETAILS
REVISE details 7, 10, and 13
ADD details 8, 12, 14, and 16

ARCHITECTURAL Sheets (A)

A010 ASSEMBLY AND PARTITION TYPES
ADD General Note – Partition Types **#6 Use on first floors up to 4 ft above finish floor. Set bottom off finish floor 1⁄2-inch.**

A111C REFLECTED CEILING PLAN
REVISE edge of ceiling step to align with revised framing.

A140 ROOF PLAN
REVISE roof drains to be north of beam below.
REVISE detail callouts to reference C3/A510 as indicated.

A510 EXTERIOR SECTION DETAILS
REVISE detail C4 to show beam and grid line F1.

A514 EXTERIOR SECTION DETAILS
REVISE framing and add dimensions on details A1 and A5 as indicated.

PLUMBING Sheets (P

P101C 1st FLOOR PLUMBING PLAN – AREA C

REVISE storm drain and overflow drain pipe up to avoid structure.

P140 PLUMBING ROOF PLAN – OVERALL
REVISE storm drain and overflow drain locations to avoid structure.

END OF ADDENDUM

Addendum 04

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01:

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	
DATE OF ISSUANCE:	08/29/2023

This Addendum is issued to modify, explain, or correct the original drawings and project manual and is hereby made a part of the Contract Documents. Please attach this Addendum to the specifications in your possession.

Each bidder shall carefully read all items in their entirety and thoroughly examine the Contract Documents to determine what extent various clarifications, changes, and conditions will affect their bid.

I. PROJECT MANUAL

SPECIFICATIONS

SECTION 00 41 13 Bid Form
See attached REVISED bid form.

END OF ADDENDUM

Addendum 05

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01:

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	
DATE OF ISSUANCE:	08/30/2023

This Addendum is issued to modify, explain, or correct the original drawings and project manual and is hereby made a part of the Contract Documents. Please attach this Addendum to the specifications in your possession.

Each bidder shall carefully read all items in their entirety and thoroughly examine the Contract Documents to determine what extent various clarifications, changes, and conditions will affect their bid.

I. PROJECT MANUAL

SPECIFICATIONS

SECTION 00 41 13 Bid Form
REVISE bid form to clarifying that Alternate 02 is NOT USED. The alternate was deleted in Addendum 02.

GENERAL SPECIFICATION NOTE
DELETE all references to Alternate 6. All items in Alternate 6 shall be included in the Base Bid Project Scope.

II. CONSTRUCTION DOCUMENTS

FIRE PROTECTION Sheets (FP) (Drawings sheets to be reissued in future document update.)

FP001 Fire Protection Code Sheet
DELETE references to Alternate 6. All items in Alternate 6 shall be included in the Base Bid Project Scope.

FP101 Fire Sprinkler Plans
DELETE references to Alternate 6. All items in Alternate 6 shall be included in the Base Bid Project Scope.

GENERAL DRAWING NOTE
DELETE all references to Alternate 6. All items in Alternate 6 shall be included in the Base Bid Project Scope.

END OF ADDENDUM

Construction Bulletin 01

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	CROSSLAND CONTRUCTION COMPANY INC.
DATE OF ISSUANCE:	11/02/2023

Please submit an itemized proposal for changes in the CONTRACT SUM and/or the CONTRACT TIME for proposed modifications to the Contract Documents described herein. This proposal must itemize all associated direct (hard) costs, indirect (soft) costs, and consequential costs.

Proceeding with the Work in accordance with these instructions prior to the acceptance by the ARCHITECT and the OWNER of the itemized proposal for changes indicates that the CONTRACTOR acknowledges that there will be no change in the CONTRACT SUM and/or the CONTRACT TIME. The CONSTRUCTION BULLETIN is an administrative form and not intended to modify the contract for construction.

This is not a CHANGE ORDER or a DIRECTION TO PROCEED with the work described in the proposed modifications.

I. PROJECT MANUAL

SPECIFICATIONS

SECTION 003131 GEOTECHNICAL DATA
ADD – new Geotechnical report dated October 4th, 2023. This report provides results of asphalt paving thickness at fire truck apparatus.

II. CONSTRUCTION DOCUMENTS

CIVIL Sheets (C)

C3.1 DETAILED HORIZONTAL CONTROL PLAN
REVISE – Fire apparatus lanes on both west and east sides of building.

ARCHITECTURAL Sheets (A)

G101 1ST FLOOR OCCUPANCY CLASSIFICATION PLAN
REVISE – Project Data, specifically gross square footage and renovation scope.

ELECTRICAL Sheets (E)

E201A ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA A
ADD - (3) exit signs in CR122 and CR120.
ADD – (1) exit sign in CR101.

E201B ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA B
RELOCATE – (1) exit sign in CR122.

E201C ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA C
ADD – (1) exit sign in CR109

Additional Documentation

Bergen Valley Elementary School Evacuation Plan.

Construction Site Logistics & Phasing Plan

END OF CONSTRUCTION BULLETIN

Construction Bulletin 02

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	CROSSLAND CONTRUCTION COMPANY INC.
DATE OF ISSUANCE:	12/13/2023

Please submit an itemized proposal for changes in the CONTRACT SUM and/or the CONTRACT TIME for proposed modifications to the Contract Documents described herein. This proposal must itemize all associated direct (hard) costs, indirect (soft) costs, and consequential costs.

Proceeding with the Work in accordance with these instructions prior to the acceptance by the ARCHITECT and the OWNER of the itemized proposal for changes indicates that the CONTRACTOR acknowledges that there will be no change in the CONTRACT SUM and/or the CONTRACT TIME. The CONSTRUCTION BULLETIN is an administrative form and not intended to modify the contract for construction.

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I. PROJECT MANUAL

SPECIFICATIONS

None

II. CONSTRUCTION DOCUMENTS

GENERAL Sheets (G)

G101 **1ST FLR OCCUPANCY CLASSIFICATION**

Revise occupant number
Revise exit width at egress doors
Remove notes of fire protection and wall rating, not applicable to this Project
Remove Office from Accessory and add to B column and update totals
Revise area per occupant & occupant number A-2 & A-3
Revise allowable area & occupant load count in Project Data

Revise applicable codes in Project Data
Added IECC C103.2 compliance chart

CIVIL Sheets (C)

C3.1 DETAILED HORIZONTAL CONTROL PLAN
REVISE fire apparatus lanes on both west and east sides of building.
REVISE ADA drop off & crosswalk.
ADD note for student drop off.

C3.3 DETAILED HORIZONTAL CONTROL PLAN
REVISE ADA drop off & crosswalk.
ADD note for student drop off.

LANDSCAPE & IRRIGATION Sheets (L & LI)

L3.0 FIELD ENLARGEMENT
REVISE enlargement plan as backstop, bleachers, and infield mix have been removed from scope.

L3.2 PLAYGROUND ENLARGEMENT
ADD accessible routes to plan.

L4.1 SITE DETAILS
REMOVE softball backstop details 3 & 4.

STRUCTURAL Sheets (S)

S001 GENERAL NOTES
REVISE design criteria, 1C) concrete note.

ARCHITECTURAL Sheets (A)

A010 ASSEMBLY & PARTITION TYPES
Remove rated stud partition note, no fire ratings in this project
Add enhanced acoustics report

A101 1ST FLR PLAN - OVERALL
Revise room name to Office
Relocate location of drinking fountain and reduce size of custodial room
Revise sheet note to FRTW

A101A 1ST FLR PLAN - AREA A
Revise room name to Office
Revise sheet note to FRTW

A101B 1ST FLR PLAN - AREA B
Revise sheet note to FRTW

A101C **1ST FLR PLAN - AREA C**
Relocate location of drinking fountain and reduce size of custodial room
Revise sheet note to FRTW
Add new elevation callout room 119, 123, 129, 131

A101C.1 **1ST FLR PLAN - AREA C DIMENSIONING**
Add clear corridor width dimensions
Relocate location of drinking fountain and reduce size of custodial room
Revise dimension at offices 135/136
Revise sheet note to FRTW

A111A **1ST FLR CEILING PLAN - AREA A**
Revised room name to Office

A111C **1ST FLR CEILING PLAN - AREA C**
Relocate location of drinking fountain and reduce size of custodial room, make updates to ceilings

A120 **1ST FLR PLAN - FINISHES**
Revised room name to Office
Relocate location of drinking fountain and reduce size of custodial room, update finishes accordingly

A140 **ROOF PLAN**
Added radius dimensions at exhaust fan

A230 **INTERIOR ELEVATIONS AND MATERIAL SCHED**
Revise keynote and add new keynote noted
Revise cubbie and coat hook elevation A1
Add elevation D4 & E6

A231 **INTERIOR ELEVATIONS**
Revise keynote and add new keynote noted
Add new elevation D5
Add new elevation B6
Revise elevation A5 with cubbie
Revise elevation C3 with coat hook
Add keynote on elevation A3

A310 **WALL SECTIONS**
Remove progress stamp

A311 **WALL SECTIONS**
Remove progress stamp

A312 **WALL SECTIONS**

Remove progress stamp

A400 ENLARGED RR FLOOR PLANS & ELEVATIONS
Revise alcove access to restrooms to eliminate sightlines issue & added turning radius dimension
Add dimension
Revise toilet elevation & room name
Rrevise toilet elevation & room name
Revise toilet elevation & room name
Revise toilet elevation & room name
Remove progress stamp

A401 ENLARGED RR FLOOR PLANS & ELEVATIONS
Add dimension
Remove progress stamp

A530 INTERIOR CASEWORK DETAILS
Revise cubbie section so complies w/ ADA reach
Remove progress stamp
Add/Revise keynotes

A600 DOOR AND FRAME SCHEDULE
Remove progress stamp

A610 SIGNAGE
Area of refuge sign details have been removed, not in scope of project.

FIRE PROTECTION Sheets (FP)

FP001 FIRE PROTECTION CODE SHEET
REVISE 2021 code notes.

PLUMBING Sheets (P)

P001 FIRE PROTECTION CODE SHEET
REVISE 2021 code notes.

MECHANICAL Sheets (M)

M001 MECHANICAL CODE SHEET
REVISE 2021 code notes.

M002 MECHANICAL SCHEDULES
REVISE pipe insulation schedule to remove IECC table C403.2.1, Note A.

M140 MECHANICAL ROOF PLAN - OVERALL
ADD intake arrow.

ELECTRICAL Sheets (E)

E000 ELECTRICAL CODE SHEET
REVISE NEC to 2023 code.
REVISE tile of upper right notes legend.

E101A ELECTRICAL 1ST FLOOR POWER PLAN – AREA A
REVISE power general notes.

E101B ELECTRICAL 1ST FLOOR POWER PLAN – AREA B
REVISE power general notes.

E101C ELECTRICAL 1ST FLOOR POWER PLAN – AREA C
REVISE power general notes.

E600 ELECTRICAL ONE LINE DIAGRAM
REVISE mechanical equipment general notes.
REVISE fault current calculation schedule.

E801 ELECTRICAL LIGHTING CONTROLS & SCHEDULES
REVISE lighting sequence of operation schedule for fixture ET2.

END OF CONSTRUCTION BULLETIN

Construction Bulletin 03

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	CROSSLAND CONTRUCTION COMPANY INC.
DATE OF ISSUANCE:	12/05/2023

Please submit an itemized proposal for changes in the CONTRACT SUM and/or the CONTRACT TIME for proposed modifications to the Contract Documents described herein. This proposal must itemize all associated direct (hard) costs, indirect (soft) costs, and consequential costs.

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This is not a CHANGE ORDER or a DIRECTION TO PROCEED with the work described in the proposed modifications.

I. PROJECT MANUAL

SPECIFICATIONS

NONE

II. CONSTRUCTION DOCUMENTS

Civil Sheets (C)

C2.0 OVERALL UTILITY SHEET

REVISE location of water line due to County comments.
REVISE connection to existing waterline per comments from County.
ADD additional utility notes.
ADD snippet of utilities located along south side building. No changes at this location.

CD2.0 UTILITY DETAILS

ADD detail 5 Tracer wire installation detail.
ADD detail 6 Gate valve detail.
ADD detail 7 Polyethylene wrap detail.
REVISE location of Concrete thrust block detail 4

END OF CONSTRUCTION BULLETIN

Construction Bulletin 04

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	CROSSLAND CONTRUCTION COMPANY INC.
DATE OF ISSUANCE:	12/15/2023

Please submit an itemized proposal for changes in the CONTRACT SUM and/or the CONTRACT TIME for proposed modifications to the Contract Documents described herein. This proposal must itemize all associated direct (hard) costs, indirect (soft) costs, and consequential costs.

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I. PROJECT MANUAL

SPECIFICATIONS

NONE

II. CONSTRUCTION DOCUMENTS

P100C UNDERGROUND PLUMBING PLAN – AREA C
REVISE underground piping due to relocation of drinking fountain.

P101C 1ST FLR PLUMBING PLAN – AREA C
REVISE piping due to relocation of drinking fountain.

P301 ENLARGED PLUMBING PLANS & ISOMETRICS
REVISE Enlarged plan C5 due to relocation of drinking fountain.

P401 PLUMBING ISOMETRICS
REVISE Isometric A & B due to relocation of drinking fountain.

M002 MECHANICAL SCHEDULES
REVISE Fan schedule as noted.

M101C 1st FLR MECHANICAL PLAN – AREA C
REVISE HVAC at Custodial room due to relocation of drinking fountain.

M140 MECHANICAL ROOF PLAN
REVISE HVAC due to relocation of drinking fountain.

E101C 1st FLR POWER PLAN – AREA C
REVISE location of drinking fountain power L1E-15 GFI to new location, contractor to markup field set.
REVISE outlet L1E-42 GFI to be on wall the west side of door, contractor to markup field set.
REVISE location of outlet on north wall Flex office 135 per new location of drinking fountain contractor to markup field set.

END OF CONSTRUCTION BULLETIN

Construction Bulletin 05

BERGEN VALLEY ELEMENTARY SCHOOL ADDITION

1422 SUGARBUSH DR

EVERGREEN, CO 80439

822808-01

OWNER:	JEFFERSON COUNTY SCHOOL DISTRICT NO. R-1
From ARCHITECT:	EPPSTEIN UHEN ARCHITECTS, INC
To CONTRACTOR	CROSSLAND CONSTRUCTION COMPANY INC.
DATE OF ISSUANCE:	01/09/2023

Please submit an itemized proposal for changes in the CONTRACT SUM and/or the CONTRACT TIME for proposed modifications to the Contract Documents described herein. This proposal must itemize all associated direct (hard) costs, indirect (soft) costs, and consequential costs.

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This is not a CHANGE ORDER or a DIRECTION TO PROCEED with the work described in the proposed modifications.

I. PROJECT MANUAL

SPECIFICATIONS

NONE

II. CONSTRUCTION DOCUMENTS

CIVIL Sheets (C)

C0.0 COVER
ADD – New sheet.

CE1.0 INITIAL EROSION CONTROL PLAN
CHANGE – sheet name.

CE1.1 INTERIM EROSION CONTROL PLAN
ADD – New sheet.

CE1.2 SWMP AND EROSION CONTROL NOTES
ADD – New sheet.

CE1.3 SWMP AND EROSION CONTROL NOTES
ADD – New sheet.

CE1.4 SWMP AND EROSION CONTROL NOTES
ADD – New sheet.

CE1.5 SWMP AND EROSION CONTROL NOTES
ADD – New sheet.

C1.1 DETAILED GRADING AND DRAINAGE PLAN
ADD – New cross section profiles.

C1.2 DETAILED GRADING AND DRAINAGE PLAN
ADD – New cross section profiles.

C1.3 DETAILED GRADING AND DRAINAGE PLAN
ADD – New cross section profiles.

C1.4 DETAILED GRADING AND DRAINAGE PLAN
ADD – New cross section profiles.

C1.5 STORM SEWER PLAN AND PROFILE
ADD – New sheet.

C1.6 STORM SEWER PLAN AND PROFILE
ADD – New sheet.

C1.7 STORM SEWER PLAN AND PROFILE
ADD – New sheet.

C2.1 WATERLINE PLAN & PROFILE
ADD – New sheet.

C3.4 DETAILED HORIZONTAL CONTROL PLAN
ADD – Sight triangles as noted.

C4.0 SUGAR BUSH ACCESS RD PLAN &PROFILE
ADD – New sheet.

C4.1 SUGAR BUSH ACCESS RD PLAN &PROFILE
ADD – New sheet.

ARCHITECTURAL Sheets (A)

A111A 1ST FLR CEILING PLAN - AREA A
ADD - note 6" bulkheads at ceiling ACT tag.
REVISE – light fixtures at main entry ceiling.

A111C 1ST FLR CEILING PLAN - AREA C
ADD - soffit section detail & add dimensions for light fixture placement.

A201 EXTERIOR ELEVATIONS
REMOVE – metal panel joints A1 elevation.
ADD - structural column visibility A1 elevation.

A230 INTERIOR ELEVATIONS AND MATERIAL SCHED
REVISE - cabinet height and revised counter to include backsplash.
ADD/REVISE - PLAM to schedule.
ADD LAM-1 to C4 elevation.

A231 INTERIOR ELEVATIONS
REVISE - cabinet height and revised counter to include backsplash.

A511 EXTERIOR SECTION DETAILS
ADD - soffit section detail.

A522 DETAILS MAIN LOBBY
REVISE – ceiling height.
REVISE – plan & elevations – casework feature had to be lowered w/ lowering of ceiling.
REVISE - note to FRTW.

A530 INTERIOR CASEWORK DETAILS
REVISE cubbie dimension to match elevation.

ELECTRICAL Sheets (E)

ED201A ELECTRICAL DEMOLITION LIGHTING PLAN – AREA A
RELOCATE – existing exterior fixture.
ADD – existing exterior fixture to be relocated.

E101C ELECTRICAL 1ST FLOOR POWER PLAN – AREA C
RELOCATE – power devices to match adjusted floorplan.

E103 ELECTRICAL ROOF PLAN - OVERALL
REMOVE – WP, GFI convenience receptacle.
ADD – keynote #1.

E201A ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA A
RELOCATE – Y1 fixtures from wall to ceiling in BOYS RR 180, GIRLS RR 138, BOYS RR 114, GIRLS RR 103.
ADD – missing ID tags to light fixtures in GIRLS RR 138, BOYS RR 180.
REMOVE – L7 fixtures in CORRIDOR CR100.

ADD – downlights in CORRIDOR CR100.
REVISE – length and location of L8 fixture in CORRIDOR CR100.
REVISE – keynote #2.
ADD – (2) Y1 fixtures in BOYS RR 169, GIRLS RR 158.
ADD – Detail #2/E201A and detail #3/E201A.
REMOVE – nightlights in corridors.
ADD – zone tags for ED1 fixtures outside VESTIBULE 100.

E201B ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA B
REMOVE – gym lighting alternate notes
REMOVE – (1) EW1EM and (1) EW1 fixture from east side of building.
ADD – (1) Y1 fixture to CORRIDOR CR112.
REMOVE – nightlights in corridors.

E201C ELECTRICAL 1ST FLOOR LIGHTING PLAN – AREA C
RELOCATE – L1 lights in STORAGE 118, STORAGE 122B, STORAGE 127B, CUST 125, STORAGE 121, STORAGE 130 from ceiling to wall.
RELOCATE – lights in FLEX OFFICE 135, FLEX 136 to match new layout.
REMOVE – (2) L10-6 light fixtures from LOBBY CR106.
ADD – (2) L11-6 light fixtures in LOBBY CR106
REVISE – All exterior building mounted lights changed to zone z4.
ADD – keynote #1.
ADD – keynote #2.
ADD – (1) Y1 to LOBBY CR106.
REMOVE – (2) EW1EM light fixtures from outside VEST 116.
REMOVE – nightlights in corridors.
ADD – emergency battery backup to fixture outside VEST 166 (replaced EL1-14 fixture with EL1EM-14).
ADD – zone tags and keynote #1 to new and relocated exterior lights.
REMOVE – (1) EW1 fixture from east side of building.
ADD – (1) relocated fixture on east side of building (RL).

E600 ELECTRICAL ONE-LIN DIAGRAM
REVISE – electrical connection requirements for B-1 and B-2.

E710 ELECTRICAL PANEL SCHEDULES
ADD – Load from feed through to Panel P1D.
REVISED – circuiting in Panel P2D for boilers, B-1 and B-2, based on approved mechanical equipment submittals.
REVISED – circuit breaker sizes in Panel H1E to match notes in panelboard submittal review.
REVISED – circuit breaker sizes in Panel L1E to match notes in panelboard submittal review.
ADD – GFI protection to EWC breakers to match notes in panelboard submittal review.
REMOVED – load from circuit L1E-1 (previously roof convenience outlet).

E711 ELECTRICAL DETAILS
REMOVED – exterior lights from relay panel schedule.

E800 ELECTRICAL LIGHTING SCHEDULES
REVISED – description for Type L1 (no change to fixture specification).
REVISED – mounting location for Type L1 from suspended to wall surface.
REMOVED – type L7 from fixture schedule to match notes in lighting submittal review.
REVISED – specification for Type L8 to match notes in lighting submittal review.
REVISED – specification for Type L10-6 to match notes in lighting submittal review.

ADDED – type L11-6 to match notes in lighting submittal review.
REVISED – type EL1-14 to have integral emergency backup. Type name changed from EL1-14 to EL1EM-14.
REVISED – type EL1-# lumen output and wattage changed to lower output.
ADDED – Lighting Fixture Specific Note #6.
REMOVE – Type EL1-14
ADD – Type EL1EM-14.
REVISE – output for type EL1 fixtures to match notes in lighting submittal review.

E801 ELECTRICAL LIGHTING CONTROLS SCHEDULES

REVISED – Lighting Sequence of Operation description for O2 to match notes in lighting controls submittal review.
ADDED – zones to Wireless Lighting Zone Schedule.
ADDED – notes block under Wireless Lighting Zone Schedule.

END OF CONSTRUCTION BULLETIN

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SECTION 01 10 00
SUMMARY

PART 1 GENERAL

1.01 PROJECT

A. Project ID: F04600A01

B. Project Name: Bergen Valley Elementary - School Addition and Renovation

C. Owner's Name: Jefferson County School District No. R-1

D. Architect's Name: Eppstein Uhen Architects.

E. The Project consists of a Limited renovation is proposed within the existing school. Finish upgrades of flooring, ceiling and wall paint along with minor reconfiguring of spaces is planned for the existing building. A new 1-story addition is planned for on the north side of existing building. A new fire suppression system will be installed in both the existing and addition. A new fire alarm in the addition along with voice evac will also be provided in existing and addition spaces..

1.02 CONTRACT DESCRIPTION

A. Contract Type: A single prime contract.

1.03 OWNER OCCUPANCY

A. Owner intends to continue to occupy adjacent portions of the existing building during the entire construction period.

B. Owner intends to occupy the Project upon Substantial Completion.

C. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.

D. Schedule the Work to accommodate Owner occupancy.

1.04 CONTRACTOR USE OF SITE AND PREMISES

A. Construction Operations:
   1. Locate and conduct construction activities in ways that will limit disturbance to site.

B. Arrange use of site and premises to allow:
   1. Owner occupancy.

C. Provide access to and from site as required by law and by Owner:
   1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
   2. Do not obstruct roadways, sidewalks, or other public ways without permit.

D. Existing building spaces may not be used for storage.

E. Utility Outages and Shutdown:
   1. Limit disruption of utility services to hours the building is unoccupied.
   2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to Owner and authorities having jurisdiction.
   3. Prevent accidental disruption of utility services to other facilities.

END OF SECTION

SECTION 01 21 00
ALLOWANCES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Lump-sum allowances.

1.02 RELATED REQUIREMENTS

A. Section 01 20 00 - Price and Payment Procedures: Additional payment and modification procedures.

1.03 LUMP-SUM ALLOWANCES

A. Allowance shall include cost to Contractor of specific products and materials ordered by Owner or selected by Architect under allowance and shall include taxes, freight, and delivery to the Project site.

B. Unless otherwise indicated, Contractor's costs for receiving and handling at Project site, labor, installation, overhead and profit, and similar costs related to products and materials under allowance shall be included as part of the Contract Sum and not part of the allowance.

C. Unused Materials: Return unused materials purchased under an allowance to manufacturer or supplier for credit to Owner, after installation has been completed and accepted.

1.04 ALLOWANCES SCHEDULE

A. Allowance 01: Section 27 51 16 Public Address Sound System. Include the sum of $50,000.00 to provide a sound system in the Existing Gym.

B. Allowance 02: Emergency Responder Bi-Directional Amplification (BDA) System Include the sum of $50,000.00 to provide a radio amplification system in the event that radio amplification is required by first responders (fire and police) for enhanced building radio coverage.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 01 23 01
ALTERNATES

PART 1 - GENERAL

1.01 SUMMARY

A. This Section includes administrative and procedural requirements for alternates.

1.02 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the Bidding Requirements that may be added to or deducted from the Base Bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
   1. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.03 PROCEDURES

A. Make certain the Bid Form clearly states that costs listed for each alternate include costs of related coordination, modification, or adjustment. If not clearly stated, revise first paragraph and subparagraph below by stating this requirement.

B. Coordination: Modify or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
   1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

C. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated modifications to alternates.

D. Execute accepted alternates under the same conditions as other work of the Contract.

E. Schedule: A Schedule of Alternates is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS

2.01 PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.01 SCHEDULE OF ALTERNATES

A. ALTERNATE 01: LMC (Library) scope.
   1. Base Bid: Existing LMC space is to remain.
   2. Alternate: In lieu of base bid, demo existing ceilings, walls, finishes, built in casework and existing lighting as indicated on Drawings in the LMC. Provide new finishes, HVAC updates due to space reconfiuration, and lighting for the LMC space as indicated on Drawings.

B. ALTERNATE 02: Not used.

C. ALTERNATE 03: Accelerated Construction Schedule
   1. Base Bid: Construction Schedule - GC to commence construction 10/23/2023 with substantial completion 12/1/2024.
   2. Additive Alternate Bid: In lieu of base bid construction schedule - GC to commence construction 10/23/2023 with substantial completion 8/1/2024. Alternate 03 amount should only include additional costs as necessary to accelerate the schedule to meet the 8/1/2024 substantial completion date.

END OF SECTION

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements

1.03 DEFINITIONS

A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
   1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
      a. Unavailability.
      b. Regulatory changes.
   2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
      a. **Substitution requests offering advantages solely to the Contractor will not be considered.**

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
   1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
   2. Agrees to provide the same warranty for the substitution as for the specified product.
   3. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to Owner.
   4. Waives claims for additional costs or time extension that may subsequently become apparent.

B. A Substitution Request for specified installer constitutes a representation that the submitter:
   1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.

C. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.

D. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
   1. Forms included in the Project Manual are adequate for this purpose, and must be used.

E. Limit each request to a single proposed substitution item.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

A. Submittal Form (before award of contract):
   1. Submit substitution requests by completing the SUBSTITUTION REQUEST FORM attached to this section. See this form for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

A. Submittal Form (after award of contract):
   1. Submit substitution requests by completing the SUBSTITUTION REQUEST FORM attached to this section. See this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

B. Substitutions will not be considered under one or more of the following circumstances:
   1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.
   2. Without a separate written request.
   3. Substitution requests offering advantages solely to the Contractor.

3.04 ACCEPTANCE

A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.05 ATTACHMENTS

A. A facsimile of the SUBSTITUTION REQUEST FORM required to be used on the Project is included after this section.

END OF SECTION

SUBSTITUTION REQUEST FORM

Bergen Valley Elementary - School Addition and Renovation

EUA project number: **822808**

To: _____From: _____

Re: _____Date: _____

Specification title: _____Description: _____

Section: _____ Page: _____Article/ paragraph: _____

Reason for not providing specified product:

Proposed substitution: _____

Manufacturer:_____

Address:_____Phone: _____

Trade name:_____Model No.: _____

History: ___New product: ___2-5 years old ___5-10 years old ___More than 10 years old
Provide and attach point-by-point comparative data. Include product description, specifications, drawings, photographs, and performance and test data adequate for evalutation of the request; applicable portions of the data are clearly identified.

Provide and attach description of changes to the contract documents that the proposed substitution will require for its proper installation.

Supporting data attached: ___Drawings ___Product Data ___Samples ___Tests ___Reports
Savings to Owner for accepting substitution: ($)

The undersigned certifies:

Proposed substitution has been fully investigated to be equal or superior in all respects to specified product.
Same waranty will be furnished for proposed substitution as called for with specified product.
Same maintenance service and source of replacement parts, as applicable, is available.
Proposed substitution will have no adverse effect on other trades and will not affect or delay progress schedule.
Proposed substitution does not affect dimensions and functional clearances.
Payment will be made for changes to building design, including A/E design, detailing, and construction costs caused by the substitution.

Submitted by: _____

—

DATE:

SECTION 01 30 00
ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General administrative requirements.
B. Electronic document submittal service.
C. Preconstruction meeting.
D. Progress meetings.
E. Construction progress schedule.
F. Submittal Schedule
G. Submittals for review, information, and project closeout.
H. Number of copies of submittals.
I. Requests for Interpretation (RFI) procedures.
J. Submittal procedures.
K. Architect's Action

1.02 GENERAL ADMINISTRATIVE REQUIREMENTS

A. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
    1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
    2. Contractor and Architect are required to use this service.
    3. It is Contractor's responsibility to submit documents in allowable format.
    4. Subcontractors, suppliers, and Architect's consultants will be permitted to use the service at no extra charge.
    5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
    6. Submit one electronic copy in (PDF, MS Word, or MS Excel) format; an electronically-marked up file will be returned. Create at native size and right-side up; illegible files will be rejected.
    7. Paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
    8. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
B. Submittal Service: The selected service is:
    1. Newforma Info Exchange.

C. Training Can Be Arranged for Participants Upon Request: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.

D. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for Owner.

3.02 PRECONSTRUCTION MEETING

A. Attendance Required:
   1. Owner.
   2. Architect.
   3. Contractor.

B. Agenda:
   1. Execution of Owner-Contractor Agreement.
   2. Submission of executed bonds and insurance certificates.
   3. Distribution of Contract Documents.
   4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
   5. Designation of personnel representing the parties to Contract and .
   6. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
   7. Scheduling.

C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.03 PROGRESS MEETINGS

A. Attendance Required:
   1. Contractor.
   2. Owner.
   3. Architect.
   4. Contractor's superintendent.
   5. Major subcontractors.

B. Agenda:
   1. Review minutes of previous meetings.
   2. Review of work progress.
   3. Field observations, problems, and decisions.
   4. Identification of problems that impede, or will impede, planned progress.
   5. Review of submittals schedule and status of submittals.
   6. Maintenance of progress schedule.
   7. Corrective measures to regain projected schedules.
   8. Planned progress during succeeding work period.
   9. Maintenance of quality and work standards.
   10. Effect of proposed changes on progress schedule and coordination.
   11. Other business relating to work.

C. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, Owner, participants, and those affected by decisions made.

3.04 CONSTRUCTION PROGRESS SCHEDULE

A. Bar-Chart Schedule: Prepare a fully developed, horizontal bar- chart type Contractor's construction schedule. Submit within 30 days of the date established for "Commencement of the Work".
   1. Provide a separate time bar for each significant construction activity. Provide a continuous vertical line to identify the first working day of each week. Use the same breakdown of units of the Work as indicated in the "Schedule of Values".
   2. Within each time bar indicate estimated completion percentage in 10 percent increments. As Work progresses, place a contrasting mark in each bar to indicate Actual Completion.

3. Prepare the schedule of sufficient width to show data for the entire construction period.
4. Secure time commitments for performing critical elements of the Work from parties involved. Coordinate each element on the schedule with other construction activities; include minor elements involved in the sequence of the Work. Show each activity in proper sequence. Indicate graphically sequences necessary for completion of related portions of the Work.
5. Coordinate the Contractor's construction schedule with the schedule of values, list of subcontracts, submittal schedule, progress reports, payment requests and other schedules.
6. Indicate completion in advance of the date established for Substantial Completion. Indicate Substantial Completion on the schedule to allow time for the Architect's procedures necessary for certification of Substantial Completion.

B. Phasing: On the schedule, show how requirements for phased completion to permit Work by separate Contractors and partial occupancy by the Owner affect the sequence of Work.

C. Work Stages: Indicate important stages of construction for each major portion of the Work, including submittal review, testing, and installation.

D. Area Separations: Provide a separate time bar to identify each major construction area for each major portion of the Work. Indicate where each element in an area must be sequenced or integrated with other activities.

E. Distribution: Following response to the initial submittal, print and distribute copies to the Architect, Owner, subcontractors, and other parties required to comply with scheduled dates. Post copies in the Project meeting room and temporary field office.
1. When revisions are made, distribute to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in construction activities.

F. Schedule Updating: Revise the schedule after each meeting, event, or activity where revisions have been recognized or made. Issue the updated schedule concurrently with the report of each meeting.

G. Schedule Updating:
1. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
2. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
3. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
    a. Include written certification that major contractors have reviewed and accepted proposed schedule.
4. Within 10 days after joint review, submit complete schedule.
5. Submit updated schedule with each Application for Payment.

3.05 REQUESTS FOR INTERPRETATION (RFI)

A. Definition: A request seeking one of the following:
1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in Contract Documents.
2. A resolution to an issue which has arisen due to field conditions and affects design intent.

B. Procedure: Immediately on discovery of the need for interpretation of the Contract Documents, and if not possible to request interpretation at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

C. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
   1. Project name.
   2. Date.
   3. Name of Contractor.
   4. Name of Architect.
   5. RFI number, numbered sequentially.
   6. Criticalness.
   7. Specification Section number and title and related paragraphs, as appropriate.
   8. Drawing number and detail references, as appropriate.
   9. Field dimensions and conditions, as appropriate.
   10. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
   11. Contractor's signature.
   12. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing interpretation.
      a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

D. General Contractor or Construction Manager shall e-mail RFIs to Architect in electronic format.
   1. Identify each page of attachments with the RFI number and sequential page number.

E. Architect's Action: Architect will review each RFI, determine action required, and return it. Allow seven working days for Architect's response for each RFI. For RFI’s that are deemed critical by the General Contractor or Construction Manager, allow two working days for Architect's response for each RFI; however, a maximum of 10% of the RFI’s can be deemed critical. RFIs received after 3:00 p.m. will be considered as received the following working day.
   1. The following RFIs will be returned without action:
      a. Requests for approval of submittals.
      b. Requests for approval of substitutions.
      c. Requests for coordination information already indicated in the Contract Documents.
      d. Requests for adjustments in the Contract Time or the Contract Sum.
      e. Requests for interpretation of Architect's actions on submittals.
      f. Incomplete RFIs or RFIs with numerous errors.
   2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
   3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
      a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly.
   1. Project name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI number including RFIs that were dropped and not submitted.
   5. RFI description.
   6. Date the RFI was submitted.
   7. Date Architect's response was received.

8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

3.06 SUBMITTAL SCHEDULE

3.07 SUBMITTALS FOR REVIEW

A. When the following are specified in individual sections, submit them for review:
   1. Product data.
   2. Shop drawings.
   3. Samples for selection.
   4. Samples for verification.

B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.

C. Samples will be reviewed for aesthetic, color, or finish selection.

D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.08 SUBMITTALS FOR INFORMATION

A. When the following are specified in individual sections, submit them for information:
   1. Design data.
   2. Certificates.
   3. Test reports.
   4. Inspection reports.
   5. Manufacturer's instructions.
   6. Manufacturer's field reports.
   7. Other types indicated.

B. Submit for Architect's knowledge as contract administrator or for Owner.

3.09 SUBMITTALS FOR PROJECT CLOSEOUT

A. Submit Correction Punch List for Substantial Completion.

B. Submit Final Correction Punch List for Substantial Completion.

C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
   1. Project record documents.
   2. Operation and maintenance data.
   3. Warranties.
   4. Bonds.
   5. Other types as indicated.

D. Submit for Owner's benefit during and after project completion.

3.10 NUMBER OF COPIES OF SUBMITTALS

A. Electronic Documents: Submit one electronic copy in PDF format; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.

B. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
   1. After review, produce duplicates.
   2. Retained samples will not be returned to Contractor unless specifically so stated.

3.11 SUBMITTAL PROCEDURES

A. General Requirements:

3.12 ARCHITECT'S ACTION

A. Action Stamp: The Architect will stamp each submittal with a uniform, action stamp. The Architect will mark the stamp appropriately to indicate the action taken, as follows:

1. Final Unrestricted Release: When the Architect marks a submittal "***REVIEWED WITH NO COMMENTS***," the Work covered by the submittal may proceed provided it complies with requirements of the Contract Documents. Final payment depends on that compliance.
2. Final-But-Restricted Release: When the Architect marks a submittal "***REVIEWED WITH COMMENTS AS NOTED***," the Work covered by the submittal may proceed provided it complies with notations or corrections on the submittal and requirements of the Contract Documents. Final payment depends on that compliance.
3. Returned for Resubmittal: When the Architect marks a submittal "***REVISE AND RESUBMIT***" or "**REJECTED - SEE COMMENTS,"** do not proceed with Work covered by the submittal, including purchasing, fabrication, delivery, or other activity. Revise or prepare a new submittal according to the notations; resubmit without delay. Repeat if necessary to obtain different action mark.
    a. Do not use, or allow others to use, submittals marked "***REVISE AND RESUBMIT***" or "***REJECTED - SEE COMMENTS***," at the Project Site or elsewhere where Work is in progress.
4. Other Action: Where a submittal is for information or record purposes or special processing or other activity, the Architect will return the submittal marked "Action Not Required."

B. Unsolicited Submittals: The Architect will return unsolicited submittals to the sender without action.

END OF SECTION

SECTION 01 40 02
PROJECT COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General Conditions and other Division-1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes administrative and supervisory requirements necessary for coordinating construction operations including, but not necessarily limited to, the following:
   1. General Project Coordination Procedures.
   2. Coordination Drawings
   3. Electronic File Sharing.
   4. Administrative and Supervisory Personnel
   5. Cleaning and Protection

B. Related Sections: The following Sections contain requirements that relate to this Section:
   1. Section 01 30 00 - Administrative Requirements: For preparing and submitting the Contractor's Construction Schedule".
   2. Section 01 30 00 - Administrative Requirements: For progress meetings, coordination meetings, and preinstallation conferences.
   3. Section 01 60 00 - Product Requirements: For coordinating general installation.
   4. Section 01 70 00 - Execution and Closeout Requirements: For coordinating contract closeout.

1.03 COORDINATION

A. Coordinate construction operations included in various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in the sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
   3. Make provisions to accommodate items scheduled for later installation.

B. Where necessary, prepare memoranda for distribution to each party involved outlining special procedures required for coordination. Include such items as required notices, reports, and attendance at meetings.
   1. Prepare similar memoranda for the Owner and separate Contractors where coordination of their Work is required.

C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of schedules.
   2. Installation and removal of temporary facilities.
   3. Delivery and processing of submittals.
   4. Progress meetings.
   5. Project Close-out activities.

D. Electronic File Sharing Procedures: Electronic files shared by the architect are developed to a minimum level of development (LOD) 200 as defined in AIA G202-2013 and is only to be used to coordinate the work. Such coordination procedures include, but are not limited to, the following:
   1. System coordination.
   2. Construction trade coordination.

1.04 SUBMITTALS

A. Coordination Drawings: Prepare coordination drawings where careful coordination is needed for installation of products and materials fabricated by separate entities. Prepare coordination drawings where limited space availability necessitates maximum utilization of space for efficient installation of different components.
   1. Show the relationship of components shown on separate Shop Drawings.
   2. Indicate required installation sequences.
   3. Comply with requirements contained in Section 01 30 00 - Administrative Requirements.

B. Staff Names: Prior to the commencing of construction operations, submit a list of the Contractor's principal staff assignments, including the superintendent and other personnel in attendance at the Project Site. Identify individuals and their duties and responsibilities. List their addresses and telephone numbers.
   1. Post copies of the list in the Project meeting room, the temporary field office, and each temporary telephone.

PART 2 - PRODUCTS (NOT APPLICABLE).

PART 3 - EXECUTION

3.01 GENERAL COORDINATION PROVISIONS

A. Inspection of Conditions: Require the Installer of each major component to inspect both the substrate and conditions under which Work is to be performed. Do not proceed until unsatisfactory conditions have been corrected in an acceptable manner.

B. Coordinate temporary enclosures with required inspections and tests, to minimize the necessity of uncovering completed construction for that purpose.

3.02 CLEANING AND PROTECTION

A. Clean and protect construction in progress and adjoining materials in place, during handling and installation. Apply protective covering where required to assure protection from damage or deterioration at Substantial Completion.

B. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to assure operability without damaging effects.

C. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period. Where applicable, such exposures include, but are not limited to, the following:
   1. Excessive static or dynamic loading.
   2. Excessive internal or external pressures.
   3. Excessively high or low temperatures.
   4. Thermal shock.
   5. Excessively high or low humidity.
   6. Air contamination or pollution.
   7. Water or ice.
   8. Solvents.
   9. Chemicals.
   10. Light.
   11. Radiation.
   12. Puncture.
   13. Abrasion.
   14. Heavy traffic.
   15. Soiling, staining, and corrosion.
   16. Bacteria.
   17. Rodent and insect infestation.
   18. Combustion.

19. Electrical current.
20. High-speed operation.
21. Improper lubrication.
22. Unusual wear or other misuse.
23. Contact between incompatible materials.
24. Destructive testing.
25. Misalignment.
26. Excessive weathering.
27. Unprotected storage.
28. Improper shipping or handling.
29. Theft.
30. Vandalism.

END OF SECTION

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SECTION 01 50 00
TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Temporary telecommunications services.

B. Temporary sanitary facilities.

C. Drinking water.

D. Vehicular access and parking.

E. Waste removal facilities and services.

F. Project identification sign.

G. Field offices.

H. Hoists and miscellaneous construction aids.

I. Temporary elevator use.

J. Rodent and pest control.

1.02 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:
   1. Building Code requirements.
   2. Health and safety regulations.
   3. Utility company regulations.
   4. Police, Fire Department and Rescue Squad rules.
   5. Environmental protection regulations.
   6. Joint Commission - Hospital Accreditation Standards.

B. Standards: Comply with NFPA 241 "Standard for Safeguarding Construction, Alterations, and Demolition Operations," ANSI A10 Series standards for "Safety Requirements for Construction and Demolition," and NECA Electrical Design Library "Temporary Electrical Facilities."

C. Electrical Service: Comply with NEMA, NECA, and UL standards and regulations for temporary electric service. Install service in compliance with NFPA 70 "National Electric Code."

1.03 TELECOMMUNICATIONS SERVICES

A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization.

B. Telecommunications services shall include:
   1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
   2. Telephone Land Lines: One line, minimum; one handset per line.
   3. Internet Connections: Minimum of one; DSL modem or faster.
   4. Email: Account/address reserved for project use.
   5. Facsimile Service: Fax-to-email software on personal computer.

1.04 TEMPORARY SANITARY FACILITIES

A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.

B. Temporary toilets: Comply with regulations and health codes for the type, number, location, operation, and maintenance of fixtures and facilities. Install where facilities will best serve the Project's needs.
   1. Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Provide covered waste containers for used material.
   2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.

C. Maintain daily in clean and sanitary condition.

D. Water: Provide potable water approved by local health authorities.

1.05 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.

B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.

C. Provide protection for plants designated to remain. Replace damaged plants.

D. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.06 EXTERIOR ENCLOSURES

A. Provide temporary insulated weather tight closure of exterior openings to accommodate acceptable working conditions and protection for Products, to allow for temporary heating and maintenance of required ambient temperatures identified in individual specification sections, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

1.07 VEHICULAR ACCESS AND PARKING

A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.

B. Coordinate access and haul routes with governing authorities and Owner.

C. Provide and maintain access to fire hydrants, free of obstructions.

D. Provide means of removing mud from vehicle wheels before entering streets.

E. Existing on-site roads may be used for construction traffic.

F. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.08 WASTE REMOVAL

A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.

C. Provide containers with lids. Remove trash from site periodically.

D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.

E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.09 PROJECT IDENTIFICATION

A. Provide project identification sign of design and construction indicated on drawings.

B. Erect on site at location indicated.

C. No other signs are allowed without Owner permission except those required by law.

1.10 FIELD OFFICES

A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.

B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.

C. Locate offices a minimum distance of 30 feet from existing and new structures.

1.11 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to Date of Substantial Completion inspection.

B. Remove underground installations to a minimum depth of 2 feet. Grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing facilities used during construction to original condition.

E. Restore new permanent facilities used during construction to specified condition.

PART 2 PRODUCTS

2.01 TEMPORARY PARTITIONS

A. Provide dustproof partitions to limit dust and dirt migration and to separate occupied areas from fumes and noise.
   1. Non-fire rated partitions, fire retardant:
      a. Steel Stud framing:
      b. Fire-Retardant, Reinforced-Polyethylene Vapor Retarders: 2 outer layers of polyethylene film laminated to an inner reinforcing layer consisting of either nonwoven grid of nylon cord or polyester scrim and weighing not less than 22 lb/1000 sq. ft., with maximum permeance rating of 0.1317 perm and with flame-spread and smoke-developed indexes of not more than 5 and 60, respectively.
         1) Raven Industries Inc.; DURA-SKRIM 2FR.
         2) Reef Industries, Inc.; Griffolyn T-55 FR.
      c. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
   2. Non-fire rated partions, standard:
      a. Wood strud framing, 6-mil polyethene.

2.02 EQUIPMENT

A. Temporary Lifts and Hoists: Contractors requiring temporary lifts and hoists shall provide facilities for hoisting materials and employees.

B. Electrical Outlets: Electrical Contractor shall provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

C. Electrical Power Cords: Contractors requiring power cords shall provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.

D. Lamps and Light Fixtures: Electrical Contractor shall provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

E. Heating Units: General Contractor shall provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

F. First Aid Supplies: General Contractor shall provide first aid supplies complying with governing regulations.

G. Fire Extinguishers: General Contractor shall provide hand-carried, portable UL-rated, fire extinguishers of NFPA recommended classes for the exposures, extinguishing agent and size required by location and class of fire exposure.

PART 3 EXECUTION

3.01 TEMPORARY FIRE PROTECTION:

A. Until fire protection needs are supplied by permanent facilities, General Contractor shall install and maintain temporary fire protection facilities of the types needed to protect against reasonably

predictable and controllable fire losses.

B. Comply with NFPA 10 "Standard for Portable Fire Extinguishers," and NFPA 241 "Standard for Safeguarding Construction, Alterations and Demolition Operations."

C. Locate fire extinguishers where convenient and effective for their intended purpose.

D. Store combustible materials in containers in fire-safe locations.

E. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires.

F. Prohibit smoking on the premises.

G. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

H. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site.

I. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

3.02 COLLECTION AND DISPOSAL OF WASTE:

A. Collect waste from construction areas and elsewhere daily.

B. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly.

C. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F .

D. Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.03 SECURITY ENCLOSURE AND LOCKUP:

A. Install substantial temporary enclosure of partially completed areas of construction.

B. Provide locking entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.

C. Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup.

D. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

3.04 ENVIRONMENTAL PROTECTION:

A. Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result.

B. Avoid use of tools and equipment which produce harmful noise.

C. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

END OF SECTION

SECTION 01 57 19
TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Construction procedures to promote adequate indoor air quality after construction.

B. Building flush-out after construction and before occupancy.

C. Testing indoor air quality after completion of construction.

D. Testing air change effectiveness after completion of construction.

1.02 PROJECT GOALS

A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
   1. Cleaning of ductwork is not contemplated under this Contract.
   2. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.

B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
   1. Furnish products meeting the specifications.
   2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

C. Ventilation: HVAC system has been designed to achieve the minimum requirements for ventilation specified in ASHRAE 62.1 with air change effectiveness of 0.9 or greater.

1.03 RELATED REQUIREMENTS

A. Section 01 40 00 - Quality Requirements: Testing and inspection services.

B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

C. Section 23 40 00 - HVAC Air Cleaning Devices: HVAC filters.

D. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC: Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.

1.04 REFERENCE STANDARDS

A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size 2012, with 2015 amendments.

B. ASHRAE Std 129 - Measuring Air-Change Effectiveness. 1997 (Reaffirmed 2002).

C. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology) 2009.

D. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization 2010.

E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers; California Department of Public Health v1.1, 2010.

F. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air April 1990.

G. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air Jan-99.

H. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction 2007.

1.05 DEFINITIONS

A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.

B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.

C. Particulates: Dust, dirt, and other airborne solid matter.

D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Indoor Air Quality Management Plan: Describe in detail measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
   1. Submit not less than 60 days before enclosure of building.
   2. Identify potential sources of odor and dust.
   3. Identify construction activities likely to produce odor or dust.
   4. Identify areas of project potentially affected, especially occupied areas.
   5. Evaluate potential problems by severity and describe methods of control.
   6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
   7. Describe cleaning and dust control procedures.

C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.

D. Duct and Terminal Unit Inspection Report.

E. Air Contaminant Test Plan: Identify:
   1. Testing agency qualifications.
   2. Locations and scheduling of air sampling.
   3. Test procedures, in detail.
   4. Test instruments and apparatus.
   5. Sampling methods.

F. Air Contaminant Test Reports: Show:
   1. Location where each sample was taken, and time.
   2. Test values for each air sample; average the values of each set of 3.
   3. HVAC operating conditions.
   4. Certification of test equipment calibration.
   5. Other conditions or discrepancies that might have influenced results.

G. Ventilation Effectiveness Test Plan: Identify:
   1. Testing agency qualifications.
   2. Description of test spaces, including locations of air sampling.
   3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
   4. Test instruments and apparatus; identify tracer gas to be used.
   5. Sampling methods.

H. Ventilation Effectiveness Test Reports: Show:
   1. Include preliminary tests of instruments and apparatus and of test spaces.
   2. Calculation of ventilation effectiveness, E.
   3. Location where each sample was taken, and time.
   4. Test values for each air sample.
   5. HVAC operating conditions.
   6. Other information specified in ASHRAE Std 129.
   7. Other conditions or discrepancies that might have influenced results.

PART 2 PRODUCTS

2.01 MATERIALS

A. Low VOC Materials: See Section 01 61 16.

B. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

A. Prevent the absorption of moisture and humidity by adsorptive materials by:
   1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.
   2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
   3. Provide sufficient ventilation for drying within reasonable time frame.

B. Begin construction ventilation when building is substantially enclosed.

C. Do not store construction materials or waste in mechanical or electrical rooms.

D. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
   1. Inspect duct intakes, return air grilles, and terminal units for dust.
   2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
   3. Clean tops of doors and frames.
   4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
   5. Clean return plenums of air handling units.
   6. Remove intake filters last, after cleaning is complete.

E. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.

F. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.02 BUILDING FLUSH-OUT

A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.

B. Perform building flush-out before occupancy.

C. Do not start flush-out until:
   1. All construction is complete.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
   4. New HVAC filtration media have been installed.

D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
   1. Obtain Owner's concurrence that construction is complete enough before beginning flush-out.
   2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
   3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
   4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
      a. Begin ventilation at least three hours prior to daily occupancy.
      b. Continue ventilation during all occupied periods.
      c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.

E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.03 AIR CONTAMINANT TESTING

A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.

B. Perform air contaminant testing before occupancy.

C. Do not start air contaminant testing until:
   1. All construction is complete, including interior finishes.
   2. HVAC systems have been tested, adjusted, and balanced for proper operation.
   3. New HVAC filtration media have been installed.

D. Indoor Air Samples: Collect from spaces representative of occupied areas:
   1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
   2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
   3. Collect samples from height from 36 inches to 72 inches above floor.
   4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
   5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
   6. When retesting the same building areas, take samples from at least the same locations as in first test.

E. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.

F. Analyze air samples and submit report.

G. Air Contaminant Concentration Limits:
   1. Formaldehyde: Not more than 27 parts per billion.
   2. PM10 Particulates: Not more than 50 micrograms per cubic meter.
   3. Total Volatile Organic Compounds (TVOCs): Not more than 500 micrograms per cubic meter.
   4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: Allowable concentrations listed in Table 4-1.
   5. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.

H. Air Contaminant Concentration Test Methods:
   1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6.
   2. Particulates: EPA 600/4-90/010 Method IP-10.
   3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
   4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
   5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.

I. Air Contaminant Concentration Determination and Limits:
   1. Carbon Monoxide: Not more than 9 parts per million and not more than 2 parts per million higher than outdoor air.
   2. Airborne Mold and Mildew: Measure in relation to outside air ; not higher than outside air.
   3. Formaldehyde: Not more than 27 parts per billion.
   4. Formaldehyde: Measure in micrograms per cubic meter, in relation to outside air ; not more than 20 micrograms per cubic meter higher than outside air.
   5. Total Volatile Organic Compounds (TVOC): Not more than 500 micrograms per cubic meter.
   6. Total Volatile Organic Compounds (TVOC): Measure in micrograms per cubic meter, in relation to outside air ; not more than 200 micrograms per cubic meter higher than outside air.

7. Particulates (PM10): Not more than 50 micrograms per cubic meter.
8. Total Particulates (PM): Measure in micrograms per cubic meter, in relation to outside air ; not more than 20 micrograms per cubic meter higher than outside air.

3.04 VENTILATION EFFECTIVENESS TESTING

A. Perform ventilation effectiveness testing before occupancy.

B. Do not begin ventilation effectiveness testing until:
   1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
   2. Building flush-out or air contaminant testing has been completed satisfactorily.
   3. New HVAC filtration media have been installed.

C. Test each air handler zone in accordance with ASHRAE Std 129.

D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust, and retest at no cost to Owner.

END OF SECTION

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SECTION 01 60 00
PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Transportation, handling, storage and protection.

B. Product option requirements.

C. Substitution limitations.

D. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

A. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.

B. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.

C. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.

D. Section 22 05 13 - Common Motor Requirements for Plumbing Equipment: Motors for plumbing equipment.

E. Section 23 05 13 - Common Motor Requirements for HVAC Equipment: Motors for HVAC equipment.

1.03 REFERENCE STANDARDS

A. NEMA MG 1 - Motors and Generators 2014.

1.04 SUBMITTALS

A. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project. All Submittal documentation, including sustainability/material transparency, should be submittal at the same time.

B. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
   1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

PART 2 PRODUCTS

2.01 NEW PRODUCTS

A. Provide new products unless specifically required or permitted by Contract Documents.

B. Use of products having any of the following characteristics is not permitted:
   1. Made using or containing CFCs, HCFCs, PCBs, BPA, CPVC, perfluorinated compounds (PFCs), polyvinylidene chloride (PVDC), added formaldehyde, mercury, creosote, arsenic, and/or pentachlorophenol.
   2. Made of wood from newly cut old growth timber.

C. Where other criteria are met, Contractor shall give preference to products that:
   1. If used on interior, have lower emissions, as defined in Section 01 61 16.
   2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
   3. Contain a lower amount of mercury

D. Motors: Refer to Section 22 05 13 - Common Motor Requirements for Plumbing Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

E. Motors: Refer to Section 23 05 13 - Common Motor Requirements for HVAC Equipment, NEMA MG 1 Type. Specific motor type is specified in individual specification sections.

2.02 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: Use a product of one of the manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named.

2.03 MAINTENANCE MATERIALS

A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.

B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

A. See Section 01 25 00 - Substitution Procedures.

3.02 TRANSPORTATION AND HANDLING

A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.

B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.

C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.

D. Transport and handle products in accordance with manufacturer's instructions.

E. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.

F. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

G. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.

H. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.03 STORAGE AND PROTECTION

A. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.

B. Store and protect products in accordance with manufacturers' instructions.

C. Store with seals and labels intact and legible.

D. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.

E. A separate area is designated to store and protect absorptive materials, including but not limited to: carpets, acoustical ceiling panels, fabric wall coverings, insulation, upholstery, and furnishings.

F. For exterior storage of fabricated products, place on sloped supports above ground.

G. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.

H. Comply with manufacturer's warranty conditions, if any.

I. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

J. Prevent contact with material that may cause corrosion, discoloration, or staining.

K. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

L. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

END OF SECTION

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SECTION 01 70 00
EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
   1. Structural integrity of any element of Project.
   2. Integrity of weather exposed or moisture resistant element.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight exposed elements.
   5. Work of Owner or separate Contractor.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

A. New Materials: As specified in product sections; match existing products and work for patching and extending work.

B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.

C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.

B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.

C. Examine and verify specific conditions described in individual specification sections.

D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.

E. Verify that utility services are available, of the correct characteristics, and in the correct locations.

F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.

B. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.

C. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.

D. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.

E. Make neat transitions between different surfaces, maintaining texture and appearance.

3.04 CUTTING AND PATCHING

A. Whenever possible, execute the work by methods that avoid cutting or patching.

B. Perform whatever cutting and patching is necessary to:
   1. Complete the work.
   2. Fit products together to integrate with other work.
   3. Provide openings for penetration of mechanical, electrical, and other services.
   4. Match work that has been cut to adjacent work.
   5. Repair areas adjacent to cuts to required condition.
   6. Repair new work damaged by subsequent work.
   7. Remove samples of installed work for testing when requested.
   8. Remove and replace defective and non-complying work.

C. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.

D. Employ original installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.

E. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

F. Restore work with new products in accordance with requirements of Contract Documents.

G. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

H. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 00, to full thickness of the penetrated element.

I. Patching:
   1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
   2. Match color, texture, and appearance.
   3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.

3.05 PROGRESS CLEANING

A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.

B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.

C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.

D. Collect and remove waste materials, debris, and trash/rubbish from site periodically and dispose off-site; do not burn or bury.

3.06 PROTECTION OF INSTALLED WORK

A. Protect installed work from damage by construction operations.

B. Provide special protection where specified in individual specification sections.

C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.

F. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.

G. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.07 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

3.08 FINAL CLEANING

A. Use cleaning materials that are nonhazardous.

B. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.

C. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.

D. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

E. Clean filters of operating equipment.

F. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, drainage systems, and _____.

G. Clean site; sweep paved areas, rake clean landscaped surfaces.

H. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.09 CLOSEOUT PROCEDURES

A. Make submittals that are required by governing or other authorities.

B. Accompany Project Coordinator on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's Notice of Substantial Completion.

C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.

D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.

E. Conduct Substantial Completion inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.

F. Correct items of work listed in Final Correction Punch List and comply with requirements for access to Owner-occupied areas.

G. Notify Architect when work is considered finally complete and ready for Architect's Substantial Completion final inspection.

H. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.10 MAINTENANCE

A. Provide service and maintenance of components indicated in specification sections.

B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Substantial Completion or the length of the specified warranty, whichever is longer.

C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.

D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.

E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the Owner.

END OF SECTION

SECTION 01 74 19
CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

A. Owner requires that this project generate the least amount of trash and waste possible.

B. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.

C. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.

D. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
   1. Aluminum and plastic beverage containers.
   2. Corrugated cardboard.
   3. Wood pallets.
   4. Clean dimensional wood.
   5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 10 00 - Site Clearing for use options.
   6. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
   7. Bricks: May be used on project if whole, or crushed and used as landscape cover, sub-base material, or fill.
   8. Concrete masonry units: May be used on project if whole, or crushed and used as sub-base material or fill.
   9. Precast concrete panels: May be used for erosion control or landscape features.
   10. Asphalt paving: May be recycled into paving for project.
   11. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
   12. Glass.
   13. Gypsum drywall and plaster.
   14. Plastic buckets.
   15. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (http://flooring.dupont.com) and Interface (www.interfaceinc.com) conduct reclamation programs.
   16. Asphalt roofing shingles.
   17. Paint.
   18. Plastic sheeting.
   19. Rigid foam insulation.
   20. Vinyl siding.
   21. Windows, doors, and door hardware.
   22. Plumbing fixtures.
   23. Mechanical and electrical equipment.
   24. Fluorescent lamps (light bulbs).
   25. Acoustical ceiling tile and panels.

E. Contractor shall submit periodic Waste Disposal Reports; all landfill disposal, recycling, salvage, and reuse must be reported regardless of to whom the cost or savings accrues; use the same units of measure on all reports.

F. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements.

G. Methods of trash/waste disposal that are not acceptable are:
   1. Burning on the project site.

2. Burying on the project site.
3. Dumping or burying on other property, public or private.
4. Other illegal dumping or burying.
5. Incineration, either on- or off-site.

H. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

A. Section 01 10 00 - Summary: List of items to be salvaged from the existing building for relocation in project or for Owner.

B. Section 01 30 00 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.

D. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.

E. Section 01 70 00 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

F. Section 31 10 00 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.

B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.

C. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.

D. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.

E. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.

F. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.

G. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.

H. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

I. Return: To give back reusable items or unused products to vendors for credit.

J. Reuse: To reuse a construction waste material in some manner on the project site.

K. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

L. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.

M. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.

N. Toxic: Poisonous to humans either immediately or after a long period of exposure.

O. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.

P. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Submit Waste Management Plan within 10 calendar days after receipt of Notice of Award of Bid, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.

C. Waste Management Plan: Include the following information:
   1. Analysis of the trash and waste projected to be generated during the entire project construction cycle, including types and quantities.
   2. Landfill Options: The name, address, and telephone number of the landfill(s) where trash/waste will be disposed of, the applicable landfill tipping fee(s), and the projected cost of disposing of all project trash/waste in the landfill(s).
   3. Landfill Alternatives: List all waste materials that will be diverted from landfills by reuse, salvage, or recycling.
      a. List each material proposed to be salvaged, reused, or recycled.
      b. List the local market for each material.
      c. State the estimated net cost, versus landfill disposal.
   4. Meetings: Describe regular meetings to be held to address waste prevention, reduction, recycling, salvage, reuse, and disposal.
   5. Materials Handling Procedures: Describe the means by which materials to be diverted from landfills will be protected from contamination and prepared for acceptance by designated facilities; include separation procedures for recyclables, storage, and packaging.
   6. Transportation: Identify the destination and means of transportation of materials to be recycled; i.e. whether materials will be site-separated and self-hauled to designated centers, or whether mixed materials will be collected by a waste hauler.

D. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
   1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
   2. Submit Report on a form acceptable to Owner.
   3. Landfill Disposal: Include the following information:
      a. Identification of material.
      b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
      c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
   4. Recycled and Salvaged Materials: Include the following information for each:
      a. Identification of material, including those retrieved by installer for use on other projects.
      b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
      c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
      d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
      e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
   5. Material Reused on Project: Include the following information for each:
      a. Identification of material and how it was used in the project.
      b. Amount, in tons or cubic yards.
      c. Include weight tickets as evidence of quantity.

6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 3 EXECUTION

2.01 WASTE MANAGEMENT PROCEDURES

A. See Section 01 10 00 for list of items to be salvaged from the existing building for relocation in project or for Owner.

B. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.

C. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.

D. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.

E. See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

2.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.

B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, Owner, and Architect.

C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.

D. Meetings: Discuss trash/waste management goals and issues at project meetings.
   1. Prebid meeting.
   2. Preconstruction meeting.
   3. Regular job-site meetings.
   4. Job safety meetings.

E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.
   1. As a minimum, provide:
      a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
      b. Separate dumpsters for each category of recyclable.
      c. Recycling bins at worker lunch area.
   2. Provide containers as required.
   3. Provide adequate space for pick-up and delivery and convenience to subcontractors.
   4. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.

F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.

G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.

H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.

I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

END OF SECTION

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Project record documents.

B. Operation and Maintenance Data.

C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

A. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.

B. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.

C. Individual Product Sections: Specific requirements for operation and maintenance data.

D. Individual Product Sections: Warranties required for specific products or Work.

1.03 SUBMITTALS

A. Project Record Documents: Submit documents to Architect with claim for final Application for Payment.

B. Operation and Maintenance Data:
   1. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit completed documents within ten days after acceptance.
   2. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
   3. Submit two sets of revised final documents in final form within 10 days after final inspection.

C. Warranties and Bonds:
   1. For equipment or component parts of equipment put into service during construction with Owner's permission, submit documents within 10 days after acceptance.
   2. Make other submittals within 10 days after Date of Substantial Completion, prior to final Application for Payment.
   3. For items of Work for which acceptance is delayed beyond Date of Substantial Completion, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
   1. Drawings.
   2. Addenda.
   3. Change Orders and other modifications to the Contract.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Record Drawings: Legibly mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Contract drawings.

3.02 OPERATION AND MAINTENANCE DATA

A. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

B. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.

C. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

A. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 WARRANTIES AND BONDS

A. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial completion is determined.

B. Verify that documents are in proper form, contain full information, and are notarized.

C. Co-execute submittals when required.

D. Retain warranties and bonds until time specified for submittal.

END OF SECTION

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

A. Training of Owner personnel in operation and maintenance is required for:
   1. All software-operated systems.
   2. HVAC systems and equipment.
   3. Plumbing equipment.
   4. Electrical systems and equipment.
   5. Landscape irrigation.
   6. Items specified in individual product Sections.

1.02 RELATED REQUIREMENTS

A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.

B. Section 01 91 13 - General Commissioning Requirements: Additional requirements applicable to demonstration and training.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
   1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
   2. Submit one copy to the Commissioning Authority, not to be returned.
   3. Make commissioning submittals on time schedule specified by Commissioning Authority.
   4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of overall Training Plan; submit in editable electronic format, Microsoft Word 2003 preferred.

B. Draft Training Plans: Owner will designate personnel to be trained; tailor training to needs and skill-level of attendees.
   1. Submit to Commissioning Authority for review and inclusion in overall training plan.
   2. Submit not less than four weeks prior to start of training.
   3. Revise and resubmit until acceptable.
   4. Provide an overall schedule showing all training sessions.
   5. Include at least the following for each training session:
      a. Identification, date, time, and duration.
      b. Description of products and/or systems to be covered.
      c. Name of firm and person conducting training; include qualifications.
      d. Intended audience, such as job description.
      e. Objectives of training and suggested methods of ensuring adequate training.
      f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
      g. Media to be used, such a slides, hand-outs, etc.
      h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.

C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
   1. Include applicable portion of O&M manuals.
   2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
   3. Provide one extra copy of each training manual to be included with operation and maintenance data.

D. Video Recordings: Submit digital video recording of each demonstration and training session for Owner's subsequent use.
   1. Format: DVD Disc.

2. Label each disc and container with session identification and date.

1.04 QUALITY ASSURANCE

A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
   1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
   2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TRAINING - GENERAL

A. Commissioning Authority will prepare the Training Plan based on draft plans submitted.

B. Conduct training on-site unless otherwise indicated.

C. Owner will provide classroom and seating at no cost to Contractor.

D. Do not start training until Functional Testing is complete, unless otherwise specified or approved by the Commissioning Authority.

E. Provide training in minimum two hour segments.

F. The Commissioning Authority is responsible for determining that the training was satisfactorily completed and will provide approval forms.

G. Training schedule will be subject to availability of Owner's personnel to be trained; re-schedule training sessions as required by Owner; once schedule has been approved by Owner failure to conduct sessions according to schedule will be cause for Owner to charge Contractor for personnel "show-up" time.

H. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
   1. The location of the O&M manuals and procedures for use and preservation; backup copies.
   2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
   3. Typical uses of the O&M manuals.

I. Product- and System-Specific Training:
   1. Review the applicable O&M manuals.
   2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
   3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
   4. Provide hands-on training on all operational modes possible and preventive maintenance.
   5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
   6. Discuss common troubleshooting problems and solutions.
   7. Discuss any peculiarities of equipment installation or operation.
   8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
   9. Review recommended tools and spare parts inventory suggestions of manufacturers.
   10. Review spare parts and tools required to be furnished by Contractor.
   11. Review spare parts suppliers and sources and procurement procedures.

J. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 02 41 01
SELECTIVE DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises.

B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.

C. Section 01 7419 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.

D. Section 02 4100 - Demolition: Building Demolition in its entirety.

1.03 REFERENCE STANDARDS

A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.

B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2009.

1.04 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate the following:
   1. Interruption of utility services. Indicate how long utility services will be interrupted.
   2. Coordination for shutoff, capping, and continuation of utility services.
   3. Locations of proposed dust- and noise-control temporary partitions and means of egress.
   4. Coordination of Owner's partial occupancy of completed Work.

B. Inventory: After selective demolition is complete, submit a list of items that have been removed and salvaged.

C. Pre-demolition Photographs: Record existing conditions by use of preconstruction photographs. Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations.

D. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.05 DEFINITIONS

A. Demolish: Completely remove and legally dispose of off-site.

B. Recycle: Recovery of demolition waste for subsequent processing in preparation for reuse.

C. Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner ready for reuse. Include fasteners or brackets needed for reattachment elsewhere.

D. Protect: Ensure item/element/structure remains damage-free until relocated off site or delivered to Owner.

E. Modify: Carefully detach from existing construction, in a manner to prevent damage, and relocate as shown in new work. Provide fasteners or brackets if necessary for reattachment.

F. Remove: Detach items from existing construction and legally dispose of off-site.

1.06 QUALITY ASSURANCE

A. Demolition Firm Qualifications: Company specializing in the type of work required.
   1. Minimum of 5 years of documented experience.
   2. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

PART 2 PRODUCTS

2.01 MATERIALS

A. REPAIR MATERIALS
   1. Use repair materials identical to existing materials.
      a. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
      b. Use materials whose installed performance equals or surpasses that of existing materials.
   2. Comply with material and installation requirements specified in individual Specification Sections.

PART 3 EXECUTION

3.01 SCOPE

A. Remove other items indicated, for salvage, relocation, recycling, and removal from premises.

B. Owner will occupy portions immediately adjacent to selective demolition so that Owner's operations will not be disrupted.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
   1. Obtain required permits.
   2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
   3. Provide, erect, and maintain temporary barriers and security devices.
   4. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
   5. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
   6. Do not close or obstruct roadways or sidewalks without permit.
   7. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
   8. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.

B. Do not begin removal until receipt of notification to proceed from Owner.

C. Protect existing structures and other elements that are not to be removed.
   1. Stop work immediately if adjacent structures appear to be in danger.

D. If hazardous materials are discovered during removal operations, stop work and notify Architect and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.

E. Perform demolition in a manner that maximizes salvage and recycling of materials.
   1. Comply with requirements of Section 01 7419 - Waste Management.
   2. Dismantle existing construction and separate materials.
   3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.

3.03 EXISTING UTILITIES

A. Protect existing utilities to remain from damage.

B. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.

C. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.

D. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.

E. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly

submit a written report to Architect.

3.04 SELECTIVE DEMOLITION FOR ALTERATIONS

A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
   1. Verify that construction and utility arrangements are as shown.
   2. Report discrepancies to Architect before disturbing existing installation.
   3. Engage a professional engineer to survey condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective demolition operations.
   4. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
   5. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

B. Separate areas in which demolition is being conducted from other areas that are still occupied.
   1. Provide, erect, and maintain temporary dustproof partitions of construction specified in Section 01 5000 in locations indicated on drawings.
   2. Provide sound retardant partitions of construction indicated on drawings in locations indicated on drawings.

C. Remove existing work as indicated and as required to accomplish new work.
   1. Remove items indicated on drawings.

D. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
   1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
   2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
   3. Verify that abandoned services serve only abandoned facilities before removal.
   4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

E. Protect existing work to remain.
   1. Prevent movement of structure; provide shoring and bracing if necessary.
   2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
   3. Repair adjacent construction and finishes damaged during removal work.
   4. Patch as specified for patching new work.

3.05 DEBRIS AND WASTE REMOVAL

A. Remove debris, junk, and trash from site.

B. Remove from site all materials not to be reused on site; comply with requirements of Section 01 7419 - Waste Management.

C. Leave site in clean condition, ready for subsequent work.

D. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 03 05 16
UNDERSLAB VAPOR BARRIER - STEGO

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sheet vapor barrier under concrete slabs on grade.

1.02 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forming and Accessories: Forms and accessories for formwork.

B. Section 03 20 00 - Concrete Reinforcing.

C. Section 03 30 00 - Cast-in-Place Concrete: Preparation of subgrade, granular fill, placement of concrete.

1.03 REFERENCE STANDARDS

A. ASTM E1643 - Standard Practice for Selection, Design, Installation and Inspection of Water Vapor Retarders Used in Contact with Earth or Granular Fill Under Concrete Slabs 2011.

B. ASTM E1745 - Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil or Granular Fill under Concrete Slabs 2011.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit manufacturers' data on manufactured products.

C. Samples: Submit samples of underslab vapor barrier to be used.

D. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction.

PART 2 PRODUCTS

2.01 MATERIALS

A. Underslab Vapor Barrier:
   1. Water Vapor Permeance: Not more than 0.010 perms, maximum.
   2. Thickness: 15 mils.
   3. Basis of Design:
      a. Stego Industries LLC; Stego Wrap Vapor Barrier (15-mil): www.stegoindustries.com/#sle.

B. Accessory Products: Vapor barrier manufacturer's recommended tape, adhesive, mastic, etc., for sealing seams and penetrations in vapor barrier.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install vapor barrier in accordance with manufacturer's instructions and ASTM E1643.

B. Install vapor barrier under interior slabs on grade; lap sheet over footings and seal to foundation walls.

C. Lap joints minimum 6 inches.

D. Seal joints, seams and penetrations watertight with manufacturer's recommended products and follow manufacturer's written instructions.

E. No penetration of vapor barrier is allowed except for reinforcing steel and permanent utilities.

F. Repair damaged vapor retarder before covering with other materials.

END OF SECTION

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SECTION 03 30 00
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
   1. Footings.
   2. Foundation walls.
   3. Slabs-on-grade.
   4. Suspended slabs.
   5. Concrete toppings.
   6. Building frame members.
   7. Building walls.

1.03 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
   1. Indicate amounts of mixing water to be withheld for later addition at Project site.
   2. Submit substantiating data for each concrete mix design contemplated for use to the Architect no less than four weeks prior to first concrete placement. Data for each mix shall include the following:
      a. Mix identification number (unique for each mix submitted).
      b. Statement of intended mix use.
      c. Mixture proportions.
      d. Water/cementitious materials ratio.
      e. Wet and dry unit weight.
      f. Total air content.
      g. Design slump and allowable range after additions of all admixtures.
      h. Compressive strength tests.
   3. Shrinkage testing per ASTM C 157.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
   1. Show all reinforcing, top and bottom profile of concrete element, supports below, including beams, columns and walls, grade beams, concrete walls, joists, etc. framing into element.
   2. Provide one continuous elevation at 1/4" (1:48) scale for all beams, joists or walls in a continuous line. Show pockets and openings in shear walls, structural slabs, beams, elevations of top of beams, walls, columns, sections through beams, pilasters, columns, and placing sequence of reinforcing for items with more than one reinforcing layer.

3. Show locations of approved construction joints, locations of pour strips, splices of reinforcing, type of splice used and splice location. Identify all ASTM A706 and epoxy coated reinforcing locations.

D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
   1. Location of construction joints is subject to approval of Architect.

E. Void Forms: Provide manufacturer's data on factory made void pieces. Submit evidence void is of proper size and shape after concrete placement. Submit evidence of void form material degradation as specified herein.

1.05 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each of the following, signed by manufacturers:
   1. Cementitious materials.
   2. Admixtures.
   3. Form materials and form-release agents.
   4. Steel reinforcement and accessories.
   5. Fiber reinforcement.
   6. Waterstops.
   7. Curing compounds.
   8. Bonding agents.
   9. Vapor retarders.
   10. Repair materials.

B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
   1. Aggregates: Submit test reports indicating that aggregates are not potentially reactive based on the ASTM C295 or ASTM 1260 testing limits set forth in section 5.1 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). Alternatively, submit ASTM C1567 test reports indicating that the combination of mix ingredients reduces the expansion due to Alkali aggregate reactivity such that the mix complies with section 5.2 of "Guide Specification for Concrete Subject to Alkali-Silica Reactions" (2007 Portland Cement Association). All tests for submitted reports shall have been performed within one year of the submittal date.

C. Minutes of preinstallation conference.

D. Placement Notification: Submit notification to Architect at least 24 hours in advance of placement.

E. Certification of chloride screen effectiveness for penetrating sealers.

F. Proposed location of saw cut joints not indicated on Drawings.

G. Curing compound data demonstrating specified moisture loss performance.

H. Evaporative retarder product and application data.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
   1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
   2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.

3. Personnel inspecting concrete reinforcing steel have current certification as an ACI Concrete Construction Inspector or have experience in concrete construction acceptable to the Architect.

D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M, "Structural Welding Code - Reinforcing Steel."

F. Formwork: Contractor shall be responsible for design and engineering of formwork. Design of formwork and preparation of formwork drawings shall be performed under supervision of a qualified engineer registered in the state of the project.

G. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5
   2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

H. Preinstallation Conference: Conduct conference at Project site
   1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
      a. Contractor's superintendent.
      b. Ready-mix concrete manufacturer.
      c. Concrete subcontractor.
      d. Special concrete finish subcontractor.
      e. Owner’s Testing/Inspection Agency.
   2. Review as applicable to Project special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, semirigid joint fillers, forms and form removal limitations, shoring and reshoring procedures, vapor-retarder installation, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.
   3. Minutes of the meeting shall be recorded by Contractor and distributed to all parties within five days. Provide one copy to Owner’s representative and Architect.

I. Record of Work: Maintain a record listing time and date of all structural concrete placement. Such record shall be kept until completion of Project and shall be available to Architect for examination at any time.

J. Pre-Placement Inspection: Formwork installation, reinforcing steel placement and installation of all items to be embedded or cast into concrete shall be verified by Contractor prior to placement.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement if present.

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.01 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

a. High-density overlay, Class 1 or better.
b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
c. Structural 1, B-B or better; mill oiled and edge sealed.
d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

D. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.

E. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads. Provide factory-made sections with curved, closed faces around drilled piers. Curved face diameter shall match drilled pier diameter. Void forms intended to remain in place after concrete placement shall degrade sufficiently within three months after concrete placement.

F. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch minimum.

G. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

H. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

I. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
1. Furnish units that will leave no corrodible metal closer than 1 1/2" inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.02 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed, where welding of reinforcement or field bending is noted on Drawings.

C. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60 ASTM A 706/A 706M for bars that may be field bent, deformed bars, ASTM A 775/A 775M or ASTM A 934/A 934M for bars that are prefabricated, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

E. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, plain steel.

2.03 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, ASTM A 775/A 775M epoxy coated.

C. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
   1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
   2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

E. Mechanical Connectors: Mechanical couplers shall develop in tension or compression, as required, at least 125% of bar yield strength. Connectors shall comply with ICC-ES acceptance criteria, ACI 133.

2.04 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
   1. Portland Cement: ASTM C 150, Type I/II. Alternate cementitious materials when proposed to control alkali-silica reactions and tested as part of a representative concrete mix in accordance with ASTM C1567, may be used subject to approval. Supplement with the following:
      a. Fly Ash: ASTM C 618, Class F or C.

B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials. All coarse and fine aggregate shall be tested per ASTM C 295 or ASTM C 1293 in accordance with section 5.1 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association).
   1. Maximum Coarse-Aggregate Size: As indicated on Drawings.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Lightweight Aggregate: ASTM C 330, with size as indicated on Drawings.

D. Water: ASTM C 94/C 94M and potable.

2.05 ADMIXTURES

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
   2. Retarding Admixture: ASTM C 494/C 494M, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
   7. Mid-Range Water Reducing Admixture: ASTM C 494/C 494M, Type A.

C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and not containing more chloride ions than are present in municipal drinking water and complying with ASTM C 494/C 494M, Type C.
   1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
      a. Axim Italcementi Group, Inc.; CATEXOL CN-CI.
      b. BASF Construction Chemicals - Building Systems; Rheocrete CNI.

c. Euclid Chemical Company (The), an RPM company; ARRMATECT, EUCON BCN, or EUCON CIA.
d. Grace Construction Products, W. R. Grace & Co.; DCI.
e. Sika Corporation; Sika CNI.

D. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. BASF Construction Chemicals - Building Systems; Rheocrete 222+.
b. Cortec Corporation; MCI- 2000 or 2005NS.
c. Grace Construction Products, W. R. Grace & Co.; DCI-S.
d. Sika Corporation; FerroGard 901.

2.06 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
a. Axim Italcementi Group, Inc.; CATEXOL CimFilm.
b. BASF Construction Chemicals - Building Systems; Confilm.
c. ChemMasters; SprayFilm.
d. Conspec by Dayton Superior; Aquafilm.
e. Dayton Superior Corporation; Sure Film (J-74).
f. Edoco by Dayton Superior; BurkeFilm.
g. Euclid Chemical Company (The), an RPM company; Eucobar.
h. Kaufman Products, Inc.; Vapor-Aid.
i. Lambert Corporation; LAMBCO Skin.
j. L&M Construction Chemicals, Inc.; E-CON.
k. Meadows, W. R., Inc.; EVAPRE.
l. Metalcrete Industries; Waterhold.
m. Nox-Crete Products Group; MONOFILM.
n. Sika Corporation; SikaFilm.
o. SpecChem, LLC; Spec Film.
p. Symons by Dayton Superior; Finishing Aid.
q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
r. Unitex; PRO-FILM.
s. Vexcon Chemicals, Inc.; Certi-Vex Envio Set.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating. Film must chemically break down in a four to six week period. Provide data from independent laboratory indicating maximum moisture less than 0.30 kg/m^2 at 72 hours when tested in accordance with ASTM C 156.

F. Clear, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Shall have test data from an independent laboratory indicating a maximum moisture less than 0.30 kg/m^2 at 72 hours when tested in accordance with ASTM C 156.
1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

G. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A. Shall have test data from an independent laboratory indicating a maximum moisture less than 0.30 kg/m^2 at 72 hours when tested in accordance with ASTM C 156.
   1. VOC Content: Curing and sealing compounds shall have a VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.07 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber

B. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

C. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

D. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

2.08 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
   4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
   1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
   2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
   3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
   4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.09 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
   1. Use a qualified testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash: 25 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 for reinforced concrete exposed to chlorides in service, 0.30 for other reinforced concrete, and 1.00 for reinforced concrete that will be dry and protected from moisture in service, percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
4. Use corrosion-inhibiting admixture in concrete where indicated.

E. Performance and Design Requirements:
1. Shrinkage: Shrinkage strain, determined in accordance with ASTM C 157 as amended and modified herein, shall not exceed the values below for each concrete class:
a. Amendments and modifications to ASTM C 157:
1) Storage: After initial 24 hour comparator reading, specimens are placed back in lime saturated water until age of seven days. At seven days another comparator reading is taken. This reading is used as the base reading which is used to calculate percent shrinkage. The specimens are stored at 50% humidity and 73° F.
2) Test Reports: Report gage length (average of three) after 4, 7, 14, 28, and 56 days. In addition to the information required by ASTM C 157, Section 11, shrinkage test reports shall include gage lengths (initial length measurements) used to determine reported shrinkage strains.
b. 28 Day Shrinkage Strain: Shrinkage strains shall not exceed the following:
1) Concrete for slab-on-grade placed directly on vapor barrier: 0.046%.
2) Concrete for bearing walls (basement walls excluded) and/or columns: 0.046%.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Proportion structural normal-weight concrete mixture as noted on Drawings, unless aggregates are “potentially reactive” with alkalis based on the ASTM C 295 or ASTM C 1260 or ASTM C 1293 testing limits of Section 5.1 of “Guide Specification of Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association). When aggregates are “potentially reactive”, compliance with Section 5.2 of “Guide Specification for Concrete Subject to Alkali-Silica Reactions” (2007 Portland Cement Association) must be established through ASTM C 1567 testing for proposed alternate concrete mixture. Submit test reports in accordance with Part I of this Specification.

2.11 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

PART 3 EXECUTION

3.01 FORMWORK

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117. Concrete adjacent to elevator hoistway shall be installed to tolerances required by elevator manufacturer.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
1. Class B, 1/4 inch for rough-formed finished surfaces.
2. The permissible irregularity is a cumulative value due to all sources including layout, plumbness, member size, formwork offsets, joints, and member levelness. The permissible irregularity shall also apply between adjacent concrete surfaces on opposite sides of construction joint, expansion joint or shrinkage pour strip if present.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
   1. Install keyways, reglets, recesses, and the like, for easy removal.
   2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. **Chamfer** exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

M. Protect void form from moisture at all times before concrete placement.

N. Voids: Provide voids of full-size and extent shown on Drawings. Specified void form may be used at the Contractor’s option. Where void forms are used below structural slab-at-grade, place 1/8 inch minimum thick masonite or plywood sheet on top of void form. Prevent concrete from entering void space.

O. All formwork surfaces that support concrete exposed to view must be accepted by Architect prior to concrete placement.

3.02 EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303 "Code of Standard Practice for Steel Buildings and Bridges."
      a. Tolerance of Embedded Items: Comply with ACI 117.
         1) Anchor Rods:
            a) Plumbness: Within +/- 1/16 inch over anchor rod projection.
         2) Embedded Plates and Weldments:
            a) Location: +/- 1 inch vertical, +/- 1 inch horizontal.
            b) Plumb and Alignment: 1/4 inch in 12 inches (1:48).
   2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
   3. Install dovetail anchor slots in concrete structures as indicated. Where masonry or veneer intersects concrete, provide one vertical dovetail slot for each 8 inches of masonry thickness. Where concrete serves as the backup, space slots at 16 inches on center.

3.03 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24

hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
3. Leave formwork and shoring in place a minimum of 15 days after concrete placement unless reshoring is used.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.04 SHORES AND RESHORES

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
   1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. In multistory construction, extend shoring or reshoring over a sufficient number of stories to distribute loads in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members without sufficient steel reinforcement.

C. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.05 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
   1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Size, length, number and placement of supports shall be sufficient as to maintain reinforcing position within specified tolerances during construction traffic and concrete placement.

E. On vertical formwork, use approved bar chairs or spacers as required to maintain concrete cover and bar position. Do not staple or use any other metallic fastener to secure bolsters, chairs, etc. to formwork for concrete surfaces exposed to exterior.

F. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

G. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.06 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
   1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated.
   2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
   3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
   4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
   5. Space vertical joints in walls as indicated. Locate joints beside piers, pilasters integral with walls, near corners, and in concealed locations where possible. Locate at centerline of support or middle third of span.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
   3. Interior Slabs-on-Grade to Receive Carpet or Wood Floor Covering: Construct slabs as large a placement area as practical. Unless noted otherwise on Drawings, locate construction joints on column centerlines. Provide control joints at column centerlines and at intervals not more than 30 feet each way.
   4. All Other Interior Slabs-on-Grade: Unless noted otherwise on Drawings, locate construction joints on column centerlines. Locate control joints where shown on Drawings. If not shown, provide control joints at column centerlines and at intervals not more than 10 feet each way.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
   2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
   3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Joints in Slabs-on-Metal Deck: Locate construction joins as shown on Drawings. For slabs with welded wire reinforcing, continue reinforcing through construction joint and lap in adjacent pour. For slabs without welded wire reinforcing, provide #4 bar 4 feet in length spaced at 12 inches on center staggered along the joint. Do not provide control joints.

F. Topping Slabs Exposed to View: Locate control joints where shown on the Contract Drawings. If not shown, locate topping slab control joints at column centerlines, over girders and at intervals not more than 10 feet each way.

3.07 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
   1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
   2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
   3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
   1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
   2. Maintain reinforcement in position on chairs during concrete placement.
   3. Screed slab surfaces with a straightedge and strike off to correct elevations.
      a. Slabs supported by metal deck shall be gaged to provide the specified slab thickness over beams.
   4. Slope surfaces uniformly to drains where required.
   5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
   1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
   2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

F. Hot-Weather Placement: Comply with ACI 301 and as follows:
   1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.08 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
   1. Apply to concrete surfaces

B. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.09 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
   1. Apply scratch finish to surfaces indicated

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
   1. Apply float finish to surfaces indicated

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
   1. Apply a trowel finish to surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system
   2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
      a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 17; for slabs-on-grade.
   3. Finish and measure surface so gap at any point between concrete surface and an unleveled, freestanding, 10-ft.- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape. Moisture-retaining-cover shall be inspected each day by Contractor. Any areas which do not show condensation on underside of cover or any slab areas which are not wet shall be immediately rewetted and cover replaced to prevent moisture loss.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer
   4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.12 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning and that are unacceptable to Architect. Allow Architect and Structural Engineer to observe concrete surfaces upon removal of forms and prior to repair of surface defects. Defects in structural concrete shall be brought to the attention of the Architect and Structural Engineer.
   1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template. Submit proposed repair to Architect for review prior to commencement of work.
1. Repair finished surfaces containing defects that are unacceptable to Architect. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings and specifications Section 014010

END OF SECTION

SECTION 03 60 00
STRUCTURAL GROUTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Structural grouting for steel bearing assemblies

1.03 ACTION SUBMITTALS

A. Product Data: For each type of grout.

B. Manufacturer's Installation Instructions: Submit manufacturer’s instructions for mixing, handling, surface preparation and placing grouts

C. Installation and Quality Control Plan. (Required for PCI Certified erectors, Optional otherwise)
   1. Plan shall include the following for each type of grouted joint, at a minimum:
      a. Preparation and Installation Procedures
      b. Methods of thermal control and curing
      c. Address verification of quality of grouting.
      d. Size of shim stacks, timing and sequence of grouting
   2. Plan shall include qualifications of personnel performing grouting operations.
   3. If plan is not submitted, grouting procedures shall comply with section 3.1.B

D. Upon completion of grouting, submit grouting records. See section 3.2.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Individuals performing grouting operations shall be qualified to perform the work.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original, unopened, undamaged packaging with manufacturer's identification. Verify product expiration dates; do not used expired product.

B. Store products in a dry location, covered, out of direct sunlight, off the ground, and protected from moisture. Maintain storage temperature required by the manufacturer. Keep materials dry until used.

C. Handle products in accordance with manufacturer’s published recommendations.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Do not perform grouting if ambient or substrate temperature does not comply with those specified by manufacturer, or otherwise proved through a documented process.

B. Maintain minimum temperature of grout and substrate specified by manufacturer before, during, and after grouting, for the duration indicated by manufacturer, or otherwise proved through a documented process to provide strength, durability and serviceability of the final product.

C. Provide appropriate protection during inclement weather.

D. Protect grout from uneven and excessive evaporation.

PART 2 PRODUCTS

2.01 GROUT MATERIALS

A. Nonmetallic, Nonshrink Grout: Complying with ASTM C 1107/C 1107M
   1. If an Installation and Quality Control Plan has been submitted, provide grout type and strength as required for structural performance.
   2. If an Installation and Quality Control Plan has not been submitted, grout shall:

a. Achieve a minimum compressive strength of 6,000 psi at 28 days.
b. Have a consistency suitable for application within a 15-minute minimum working time.
c. For poured grout, when tested in accordance with ASTM C-939 have an efflux time of 10 – 30 seconds.
d. For pumped grout, when tested in accordance with ASTM C-1437, have a flow of 124% to 145%

B. Water: Potable

C. Additives: none permitted

PART 3 EXECUTION

3.01 INSTALLATION

A. If an Installation and Quality Control Plan has been submitted and accepted, installation procedures shall follow the Installation and Quality Control Plan

B. If an Installation and Quality Control Plan has not been submitted, grouting shall follow prescriptive procedures as follows:

1. Grout joints as follows:
   a. Below steel baseplates, install grout after building is plumbed, and prior to placement of concrete on deck at floors supported by element to be grouted.
   b. All joints specified to be grouted shall be grouted prior to concealment with other materials.
   c. Other locations noted on drawings.
2. Preparation
   a. Remove dirt, oil, grease, laitance, debris, ice, snow, and other foreign material from surfaces by brushing, hammering, chipping or other similar means until sound, clean surface is achieved.
   b. Align, level, and maintain final positioning of components to be grouted.
   c. Select appropriate grouting procedure (dry packed, poured, or pumped) based on the joint geometry and drawing requirements.
   d. Saturate concrete surfaces with clean water; remove excess water, leave none standing.
   e. Protect exposed surfaces that are intended to remain clean from being stained with grout.
3. Formwork
   a. Construct leak proof forms anchored and shored to withstand grout pressures. Construct head boxes as necessary for poured or pumped grout. Apply form oil to forms.
   b. Install formwork with clearances to permit proper placement of grout.
   c. For dry packing of grout, use braced backboards with sufficient strength to pack grout against.
   d. Place grout end cap or dam in voids at ends of hollow-core slabs.
4. Mixing
   a. Mix and prepare grout in accordance with manufacturer's instructions. Do not exceed the maximum water requirements per manufacturer specifications.
   b. Mix grout components in proximity to work area and transport mixture quickly and in manner not permitting segregation of materials. Do not mix more grout than can be placed in fifteen (15) minutes.
   c. Grout temperature after mixing shall be not less than 55 degrees F, and not greater than 75 degrees F, unless otherwise specified by manufacturer, or proved through a documented process.
5. Grouting
   a. Placement shall commence immediately after mixing. Do not allow grout to set up before placement. Do not re-temper grout by adding water, and remixing after it stiffens. Discard any grout that no longer meets quality specifications.
   b. Dry Packed Grout
      1) Dry packed grouted joints are permitted only where joint is
         a) readily accessible and observable

b) placements less 12 in. deep measured from placement edge
c) joint thickness 1 in. and greater

2) Consolidate grout with a tamping rod and mallet or packing board. Tightly pack joint in layers, with each layer having a compacted thickness of 1/2 in. to 1 in.
3) Installer shall observe each layer, prior to placement of next layer, to verify the entire surface has been compacted.
4) Unless otherwise indicated in the design submittal, fill joint completely including all sides of shim stacks, and around anchors.

c. Poured Grout
1) Grout placement shall be a continuous operation until the joint is completely full.
2) Pour grout from one side of the joint only to avoid trapping air.
3) Consolidate grout to remove air pockets use a flat steel strap, or similar. Do not vibrate grout.
4) Retain flowable grout in place until hard enough to support itself. Fill joints completely without seepage to other surfaces.

d. Open Faced Pumped Grout
1) Pumped grout shall be placed using appropriate equipment.
2) Grout placement shall begin at back of joint and proceed to front, filling joint completely, without trapping air.

e. After grouting
1) Promptly remove excess grout material before grout hardens.
2) Promptly begin curing and protection of grouted material.

6. Curing
a. Cure and protect in a manner, and for a duration, recommended by the material manufacturer and ACI recommended practices, or in accordance with a written plan.
b. At a minimum, prevent rapid loss of water from grout during first 48 hours by use of approved membrane curing compound or by covering with wet polyethylene backed burlap.

7. Finishing
a. Remove or grind flush head boxes or other projections of installed grout.

3.02 FIELD QUALITY CONTROL

A. Contractor responsibility:
1. Maintain records of each grouted joint indicating:
a. Joint location
b. Grout product used
c. Grouting method used
d. Date and time of grouting
e. Air temperature, substrate temperature, grout temperature
f. Method used for thermal control
g. Curing method
h. Personnel responsible for grouting

B. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections and tests:
1. Perform periodic special inspection as follows. Periodic special inspections shall be daily while grouting work is underway.
a. Preparation of joints to be grouted
b. Mixing of grout in conformance with manufacturer instructions
c. Temperature of air, substrate, and grout
d. Placement of grout and grouting method
e. Curing procedures
f. Test grout for compliance with the following:
1) Poured grout, when tested in accordance with ASTM C-939 shall have an efflux time of 10 – 30 seconds.

2) Pumped grout, when tested in accordance with ASTM C-1437 shall have a flow of 124% to 145%

g. Where placement of concrete slabs, soil, or other construction may conceal joints, inspect joints intended to be grouted prior to concealment.

h. Prior to placement of concrete slabs supported by a column or wall, inspect that grouting has been completed below column or wall.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare inspection reports.

END OF SECTION

SECTION 04 20 00
UNIT MASONRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Concrete block.

B. Mortar and grout.

C. Reinforcement and anchorage.

D. Flashings.

E. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing control and expansion joints.

1.03 REFERENCE STANDARDS

A. ASTM A36/36M - Standard Specification for Carbon Structural Steel; 2014.

B. ASTM A82/A82M - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement; 2007.

C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2009.

D. ASTM A580/A580M - Standard Specification for Stainless Steel Wire 2015.

E. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement 2015.

F. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire 2009a (Reapproved 2014).

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

H. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

I. ASTM C55 - Standard Specification for Concrete Building Brick; 2017.

J. ASTM C62 - Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale); 2017.

K. ASTM C67/C67M - Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile 2018.

L. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units 2014.

M. ASTM C91/C91M - Standard Specification for Masonry Cement 2012.

N. ASTM C129 - Standard Specification for Nonloadbearing Concrete Masonry Units 2011.

O. ASTM C140/C140M - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units 2014.

P. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar 2011.

Q. ASTM C150/C150M - Standard Specification for Portland Cement 2015.

R. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.

S. ASTM C216 - Standard Specification for Facing Brick (Solid Masonry Units Made From Clay or Shale); 2017a.

T. ASTM C270 - Standard Specification for Mortar for Unit Masonry 2014a.

U. ASTM C404 - Standard Specification for Aggregates for Masonry Grout 2011.

V. ASTM C476 - Standard Specification for Grout for Masonry; 2018.

W. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2018a.

X. ASTM C979/C979M - Standard Specification for Pigments for Integrally Colored Concrete; 2016.

Y. ASTM C1148 - Standard Test Method for Measuring the Drying Shrinkage of Masonry Mortar; 1992a (Reapproved 2014).

Z. ASTM C1314 - Standard Test Method for Compressive Strength of Masonry Prisms; 2016.

AA. ASTM C1357 - Standard Test Methods for Evaluating Masonry Bond Strength; 2009.

BB. ASTM E514/E514M - Standard Test Method for Water Penetration and Leakage Through Masonry; 2014a.

CC. BIA Technical Notes No. 7 - Water Penetration Resistance – Design and Detailing; 2017.

DD. BIA Technical Notes No. 13 - Ceramic Glazed Brick Exterior Walls 2017.

EE. BIA Technical Notes No. 28B - Brick Veneer/Steel Stud Walls 2005.

FF. BIA Technical Notes No. 46 - Maintenance of Brick Masonry; 2017.

GG. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures 2016.

HH. UL (FRD) - Fire Resistance Directory current edition.

II. Adopted Edition of International Building Code with All Adopted State Modifications.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, and each type of product indicated.
   1. Submit the masonry manufacturer's recommendations for cleaning each masonry type used for this work, along with a written description of the Contractor's proposal for the masonry cleaning procedures.

C. Samples: Submit two samples of decorative block, facing brick, and precast concrete trim units and each mortar color to illustrate color, texture, and extremes of color range.

D. Shop drawings:
   1. Indicate bar sizes, spacings, clearances, locations, reinforcement quantities, bending and cutting schedules, supporting and spacing devices for reinforcement, and accessories.
   2. Detail bending and placement of unit masonry reinforcing bars.
   3. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."
   4. Show elevations of reinforced walls.
   5. Design and engineer anchorage for precast concrete trims and precast concrete caps. Submit detailed layout drawings and anchorage details to other construction.

E. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.

F. Manufacturer's Certificate: Certify that water repellent admixture manufacturer has certified masonry unit manufacturer as an approved user of water repellent admixture in the manufacture of concrete block.

G. Design Mix Data for Mortar: Submit design mix including mix proportions, sources of aggregates, required environmental conditions, and admixture limitations.

H. Design Mix Data for Grout: Submit design mix including mix proportions, sources of aggregates, required environmental conditions, and admixture limitations.

I. Test Reports: Submit reports on mortar indicating conformance of mortar to property requirements of ASTM C270, component mortar materials to requirements of ASTM C270 and test and evaluation reports to ASTM C780 for aggregate ratio and water content, air content, consistency and compressive strength.

J. Test Reports: Submit reports on grout indicating conformance of grout to property requirements of ASTM C476, component grout materials to requirements of ASTM C476 and test and evaluation reports per referenced standard.

K. Test Reports: Concrete masonry manufacturer's test reports for units with integral water repellent admixture.

1.05 QUALITY ASSURANCE

A. Comply with provisions of TMS 402/602, except where exceeded by requirements of Contract Documents.

B. Comply with provisions of TMS 402/602, except where exceeded by requirements of the contract documents.
   1. Maintain one copy of each document on project site.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of documented experience.

1.06 MOCK-UP

A. Before placing order of masonry materials, build mockups to verify selections made under sample Submittals, and to demonstrate aesthetic effects and qualities of materials and execution. For compliance with construction schedules and lead times of materials, proceed with mock-ups for each building at the earliest possible time. Final colors are not to be considered approved until a mock-up is completed and approved by the Owner. Build mockups to comply with the following requirements, using materials indicated for the completed Work:
   1. Build mockups for typical exterior walls, approximately 4’-0” long by 8’-0” high by full thickness including structural backup, all masonry and mortar types, window sill flashing, accessories, and a sealant-filled joint at least 16 inches long in each mockup.
   2. Clean exposed faces of mockups with masonry cleaner as indicated.
   3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
   4. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   5. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   6. Locate where directed.
   7. Mock-up may remain as part of the Work.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, handle, and store masonry units by means that will prevent mechanical damage and contamination by other materials.

B. Handle materials in a manner to prevent breakage and chipping. When stored on the site, materials shall not be in contact with the ground, shall be kept clean, and shall be covered with a waterproof, stain-proof cover. All excess masonry shall be removed from the job site.

C. All masonry units delivered for use in freezing weather shall be fully protected by a weather- tight covering to prevent accumulation of ice on the units. Loose board covering shall not be permitted.

D. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

E. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

F. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

G. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2 PRODUCTS

2.01 UNIT MASONRY, GENERAL

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry and will be within 20 feet vertically and horizontally of a walking surface.

C. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to Authorities Having Jurisdiction.
   1. Where fire-resistance-rated construction is indicated, units shall be listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.02 CONCRETE MASONRY UNITS

A. Concrete Block: Comply with referenced standards and as follows:
   1. Size: Standard units with nominal face dimensions of 16 by 8 inches and nominal depths as indicated on drawings for specific locations.
   2. Special Shapes: Provide non-standard blocks configured for corners, lintels, headers, and control joint edges.
      a. Single bullnose corner blocks, as indicated.
      b. Bullnose pilaster blocks, as indicated.

2.03 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91/C91M, Type N.
   1. Colored mortar: Premixed cement as required to match Architect's color selections.

B. Portland Cement: ASTM C150/C150M, Type I; color as required to produce approved color sample.
   1. Not more than 0.60 percent alkali.

C. Hydrated Lime: ASTM C207, Type S.

D. Mortar Aggregate: ASTM C144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
   2. For joints less than 1/4-inch-thick, use aggregate graded with 100 percent passing the No. 16 sieve.
   3. White-Mortar Aggregates: Natural white sand or crushed white stone.
   4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

E. Grout Aggregate: ASTM C404.

F. Water: Clean and potable.

G. Integral Water Repellent Admixture for Mortar: Polymeric liquid admixture added to mortar at the time of manufacture.
   1. Performance of Mortar and Grout with Integral Water Repellent:
      a. Water Permeance: When tested per ASTM E514 for a minimum of 72 hours.
         1) No water visible on back of wall above flashing at the end of 24 hours.
         2) No flow of water from flashing equal to or greater than 0.032 gallons per hour at the end of 24 hours.
         3) No more than 25% of wall area above flashing visibly damp at end of test.
      b. Flexural Bond Strength: ASTM C1357; minimum 10% increase.
      c. Compressive Strength: ASTM C1314; maximum 5% decrease.
      d. Drying Shrinkage: ASTM C1148; maximum 5% increase in shrinkage.

2. Use only in combination with masonry units manufactured with integral water repellent admixture.
3. Use only water repellent admixture for mortar from the same manufacturer as water repellent admixture in masonry units.
4. Meet or exceed performance specified for water repellent admixture used in masonry units.

H. Cold Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C and recommended by the manufacturer for use in masonry mortar of composition indicated. Do not use calcium chloride in mortar or grout. Add cold-weather admixture (if used) at the same rate for all mortar, regardless of weather conditions, to ensure that mortar color is consistent.
1. Accelguard 80; Euclid Chemical Co.
2. Morseled; W.R. Grace & Co., Construction Products Division.
3. Trimix-NCA; Sonneborn, Div of ChemRex, Inc.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 REINFORCEMENT AND ANCHORAGE

A. Manufacturers:
1. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi), deformed bars; uncoated.

C. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Interior Walls: Hot-dip galvanized, carbon steel.
2. Exterior Walls: Stainless.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

D. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.

E. Single Wythe Joint Reinforcement: Ladder type; ASTM A1064/A1064M steel wire, mill galvanized to ASTM A641/A641M, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

F. Multiple Wythe Joint Reinforcement: Ladder type; fabricated with moisture drip; ASTM A1064/A1064M steel wire, hot dip galvanized after fabrication to ASTM A153/153M, Class B; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

G. Masonry Veneer Anchors: 2-piece anchors that permit differential movement between masonry veneer and structural backup, hot dip galvanized to ASTM A153/A153M, Class B-2.
1. Description: Screw-Attached, Masonry-Veneer Anchors: Wire tie and a corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and rigid insulation, and has a gasketed washer head that covers hole in the insulation.
   a. Basis of Design: Subject to compliance with requirements, provide Hohmann & Barnard, Inc. "Thermal 2-Seal." or comparable product by one of the following:
      1) 1) Heckmann Building Products Inc.
      2) 2) Hohmann & Barnard, Inc.
      3) 3) Wire-Bond.v
2. Frequency: At minimum, locate one tie every 1.78 square feet of masonry veneer. (equivilent to 16-inches on center in each direction)

2.05 FLASHINGS

A. Concealed Flashing: York 304 Self Adhering, 2-mil flexible, stainless steel.
1. Description:

a. Type: Engineered system, with high resistant to damage, composite with a stainless steel with non-asphalt adhesive polymer fabric laminated to one stainless steel and non-woven drainage fabric laminated to opposing face with non-asphalt adhesive.
b. Stainless steel: type 304, ASTM A240.
c. Certify the use of domestic manufactured stainless steel for flashing.
1) Domestically sourced per DFARS 252.225-7008 and/or DFARS 252.225-7009.
d. Fabrics:
1) Polymer fabric; laminated back face to stainless steel core
2) Non-woven drainage fabric: Fabric laminated to front face stainless steel core.

2. Performance Attributes:
a. Puncture: 2,500 psi per ASTM E154.
b. Tensile: 100,000 per ASTM D412.

3. Warranty:
a. Manufacturer: Warrant flexible flashing/drainage system material for life of the wall.
1) Begin warranty at Date of Substantial Completion.

4. Applications: Overlap drip edge at least 1-inch.
a. Through-wall flashing.
b. Head flashing.
c. Cavity wall flashing

5. End dam: Product may be folded in line with the flashing material.
6. Outside corner and inside corner material; manufacturer's standard available units using:
a. Stainless steel: 26 gauge stainless steel.

7. Splice end joints by butting ends together over 4" wide piece of self-adhering stainless steel flashing.
a. The self-adhering stainless steel flashing should be sealed metal face down on to the substrate with the mastic.
b. Remove the release linear and butt the two piece of flashing together and embed them into the splice sealant.
c. Then seal the butt seam with sealant.
d. Splice material: Product standard of quality is York 304 by York Manufacturering, standard self-adhered metal material; material matching system material.

B. Termination Bar:
1. Manufacturer: Hohmann & Barnard, Inc.
2. Product: H & B T2-FTS (Foam-Tite Seal) - Stainless Steel Termination Bar.
a. Fasteners: Domestic manufactured fastener types and sizes recommended by flashing manufacturer for intended use.

C. Sealant at Termination Bar: Dow Corning 791 Silicone Sealant.
1. Applications:
a. At top of termination bar.
b. Continuous bead of concealed flashing overlapping drip edge.
c. Set drip edge in continuous bead of sealant.
d. Additional continuous bead below drip edge.

D. Stainless Steel Drip Edge Flashing: ASTM A666, Type 304, soft temper; 26 guage thick; with 3-inch leg and 5/16-inch hem at 45 degrees, typical. Do not purchase products manufactured, or sold by vendors from, outside the United States.
1. Set concealed flashing over continuous bead of sealant to overlap drip flashing a minimum of 1-inch.
2. Set drip flashings in continuous bead of sealantm and seal under drip.

E. Drip Edge: 24 gage x 3-inch stainless steel with drip-edge with hem at 45 degrees.
1. Certify the use of domestic manufactured stainless steel for flashing.

2.06 ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane or PVC.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC- 65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Proprietary Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

E. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
   1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
      a. Manufacturers:
         1) Mortar Net USA, Ltd; Product 90% open mesh: www.mortarnet.com.

F. Cavity Weeps and Vents: Polyester mesh.

G. Color(s): As selected by Architect from manufacturer's full range.
   1. Manufacturers:
      a. Advanced Building Products, Inc; _____: www.advancedbuildingproducts.com/#sle.
      b. Blok-Lok Limited; _____: www.blok-lok.com/#sle.
      c. Hohmann & Barnard, Inc; _____: www.h-b.com/#sle.
      d. WIRE-BOND; _____: www.wirebond.com/#sle.
      e. Mortar Net USA, Ltd; Product Mortar Net Weep Vents: www.mortarnet.com.

H. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.07 MORTAR AND GROUT MIXING

A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
   1. Masonry below grade and in contact with earth: Type M.
   2. Exterior, loadbearing masonry: Type S.
   3. Exterior, non-loadbearing masonry: Type N.
      a. Low-alkali, non-staining cement mortar shall be used. Sand shall be clean, sharp, and washed free of loam, silt and vegetable matter. White sand shall be used.
   4. Interior, loadbearing masonry: Type N.
   5. Interior, non-loadbearing masonry: Type N.

B. Grout for Unit Masonry: Comply with ASTM C476.
   1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
   2. Minimum compressive strength of grout shall be 3000 pounds per square inch at 28 days of age. Make, cure and determine strength of grout test prisms in accordance with ASTM C1019.
   3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.

D. Mixing: Use mechanical batch mixer and comply with referenced standards.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.
   1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
   2. Verify that foundations are within tolerances specified.
   3. Verify that reinforcing dowels are properly placed.
   4. Verify that substrates are free of substances that impair mortar bond.
   5. Verify that field conditions are acceptable and are ready to receive masonry.
   6. Verify that related items provided under other sections are properly sized and located.
   7. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.03 COLD AND HOT WEATHER REQUIREMENTS

A. Comply with requirements of TMS 402/602 or applicable building code, whichever is more stringent.

3.04 COURSING

A. Establish lines, levels, and coursing indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness.

C. Concrete Masonry Units:
   1. Bond: Running.
   2. Coursing: One unit and one mortar joint to equal 8 inches.
   3. Mortar Joints: Concave.

3.05 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

D. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
   1. Mix units from several pallets or cubes as they are placed.

3.06 PLACING AND BONDING

A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.

B. Remove excess mortar and mortar smears as work progresses.

C. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.

D. Interlock intersections and external corners, except for units laid in stack bond.

E. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.

F. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.

G. Cut mortar joints flush where wall tile is scheduled or resilient base is scheduled.

H. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

I. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with compressible joint filler.

J. Joints in precast concrete caps and tops of precast concrete trim:
   1. Rake joints back for installation of sealant per Section 07 90 05 - Joint Sealants.

3.07 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

F. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.
   1. Install compressible filler in joint between top of partition and underside of structure above.
   2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inchclearance between end of anchor rod and end of tube. Space anchors 48 inches o.c., unless otherwise indicated.
   3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section "Fire-Resistant Joint Systems."

3.08 LAYING CONCRETE MASONRY UNITS

A. Do not dampen units before laying. Do not lay units, which have surface water or contain frost. Lay only whole sound units with undamaged faces, corners, edges, and that are free from any other defect.

B. Lay units plumb, level, and true to a line with uniform horizontal and vertical joints; running bond or as indicated on the Drawings. Provide specialty units as required to complete the Work.

C. Lay first course of masonry in full mortar bed. Lay additional courses in full mortar bed on shell surface and at ends. Lay concrete brick, soaps, or plugs in full mortar bed with head and edge joints completely filled.

D. Lay hollow units with the thicker edge of the face shell up. Lay corners prior to laying mid-span. Rock closure units into place with the head joints shoved against the adjacent in-place units.

E. Cut units with power saw to insure straight and true cut edges. Do not use partial masonry units where whole units can be used. Use corner masonry units at all corners and perimeter of all openings, blocks with open cells exposed shall not be permitted.

F. Avoid over-plumbing and pounding of the corners and jambs to fit stretcher units after setting in place. Where adjustment must be made after initial setting, remove mortar and replace with fresh mortar.

G. Protect all projecting surfaces from droppings of mortar. Protect doorjambs, corners, and other embedded items from damage during construction.

H. Where fresh masonry joins masonry that is partially set or totally set, the exposed surface of the set masonry shall be cleaned so as to obtain the best possible bond with the new work. All loose

masonry and mortar shall be removed. If it becomes necessary to "stop-off" a horizontal run of masonry, this shall be done only by raking out the mortar joint one-half length in each course and, if grout is used, stopping grout four inches back of the rack.

I. Keep face of masonry work free from excess mortar while laying block. Brush masonry work with dry fiber brush daily.

3.09 WEEPS/CAVITY VENTS

A. Install weeps in veneer and cavity walls at 24 inches on center horizontally on top of through-wall flashing above shelf angles and lintels and at bottom of walls.

B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels and near top of walls.

3.10 CAVITY MORTAR CONTROL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.

B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.

C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.11 REINFORCEMENT AND ANCHORAGE - GENERAL

A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.
   1. Install horizontal joint reinforcing 8 inches on center at parapets.
   2. Place continuous joint reinforcement in first and second joint below top of walls.
   3. Reinforce soldier coursing, stack bonded unit with horizontal joint reinforcement 8 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place continuous joint reinforcement in first and second joint below top of walls.

D. Lap joint reinforcement ends minimum 6 inches.

E. Reinforce joint corners and intersections 16 inches o.c.
   1. Reinforce soldier coursing, stack bonded unit joint corners and intersections with strap anchors 8 inches on center.

3.12 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

A. Install horizontal joint reinforcement 16 inches on center.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

C. Place horizontal joint reinforcement at every course between clay masonry, concrete, and cast stone to address different expansion/contraction rates of materials.

D. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center. Anchors shall have a minimum embedment into the veneer of 1.5 inches.

3.13 REINFORCEMENT AND ANCHORAGE - GENERAL AND SINGLE WYTHE MASONRY

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
   1. Space reinforcement not more than 16 inches o.c.
   2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
   3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement where continuous reinforcement is indicated.

4. Reinforce joint corners and intersections 16 inches o.c.
5. Place continuous joint reinforcement in first and second joint below top of walls.
6. Lap joint reinforcement ends minimum 6 inches.
7. Reinforce stack bonded unit joint corners and intersections with strap anchors 16 inches on center.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.14 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

A. Install horizontal joint reinforcement 16 inches on center.

B. Lap joint reinforcement ends minimum 6 inches.

3.15 MASONRY FLASHINGS

A. Whether or not specifically indicated, install masonry flashing to divert water to exterior at all locations where downward flow of water will be interrupted.
1. Extend flashings full width at such interruptions and at least 4 inches into adjacent masonry or turn up at least 4 inches above top of mortar diverter (14 inches total) to form watertight pan at non-masonry construction.
2. Remove or cover protrusions or sharp edges that could puncture flashings.
3. Seal lapped ends and penetrations of flashing before covering with mortar.

B. Extend metal flashings through exterior face of masonry and terminate in an angled drip with hemmed edge. Install joint sealer below drip edge to prevent moisture migration under flashing.

C. Lap end joints of flashings at least 6 inches, minimum, and seal watertight with flashing sealant/adhesive.

3.16 LINTELS

A. Install loose steel lintels over openings.

B. Install reinforced unit masonry lintels over openings where steel or precast concrete lintels are not scheduled.
1. Openings to 42 inches: Place two, No. 3 reinforcing bars 1 inch from bottom web.
2. Openings from 42 inches to 78 inches: Place two, No. 5 reinforcing bars 1 inch from bottom web.
3. Openings over 78 inches: Reinforce openings as detailed.
4. Do not splice reinforcing bars.
5. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
6. Place and consolidate grout fill without displacing reinforcing.
7. Allow masonry lintels to attain specified strength before removing temporary supports.

C. Maintain minimum 8 inch bearing on each side of opening, unless noted as more on structural drawings.

3.17 GROUTED COMPONENTS

A. Reinforce bond beams, columns, and pilasters as scheduled on structural drawings.

B. Lap splices minimum 24 bar diameters.

C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

D. Place and consolidate grout fill without displacing reinforcing.

E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.18 CONTROL AND EXPANSION JOINTS

A. Do not continue horizontal joint reinforcement through control or expansion joints.

B. Space control joints in concrete masonry at maximum 20 ft. on center maximum, at a maximum of 4 ft. from corners, at inside corners, and as indicated on drawings.

C. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.

D. Size control joint in accordance with Section 07 92 00 for sealant performance.

E. Concrete Masonry Units
   1. Locate control joints as indicated on the Drawings but do not to exceed 20 feet on centers, at a maximum of 4 feet from corners, and at inside corners.
   2. Extend control joint through bond beams unless otherwise indicated on the Drawings.
   3. Control joints on outside face of an exterior wall shall have joint raked 3/4 inch in preparation for backer rod and sealant.
   4. Control joints on faces of interior walls exposed to public view shall have joint raked 3/8 inch in preparation for sealant.
   5. Do not install vertical control joints at the ends of masonry lintels.
   6. Form control joints in concrete masonry using one of the following methods:
      a. Fit bond-breaker strips into hollow contour in ends of concrete masonry units on one side of control joint. Fill resultant core with grout and rake out joints in exposed faces for application of sealant.
      b. Install preformed control-joint gaskets designed to fit standard sash block.
      c. Install interlocking units designed for control joints. Install bond-breaker strips at joint. Keep head joints free and clear of mortar or rake out joint for application of sealant.
      d. Install temporary foam-plastic filler in head joints and remove filler when unit masonry is complete for application of sealant.

F. Brick
   1. Space control joints in concrete masonry at maximum 20 ft. on center maximum, at a maximum of 4 ft. from corners, at inside corners, and as indicated on drawings.

3.19 BUILT-IN WORK

A. As work progresses, install built-in metal door frames and glazed frames and other items to be built into the work and furnished under other sections.

B. Install built-in items plumb, level, and true to line.

C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
   1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

D. Do not build into masonry construction organic materials that are subject to deterioration.

3.20 TOLERANCES

A. Maximum Variation from Alignment of Columns: 1/4 inch.

B. Maximum Variation From Unit to Adjacent Unit: 1/16 inch.

C. Maximum Variation from Plane of Wall: 1/4 inch in 10 ft and 1/2 inch in 20 ft or more.

D. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in two stories or more.

E. Maximum Variation from Level Coursing: 1/8 inch in 3 ft and 1/4 inch in 10 ft; 1/2 inch in 30 ft.

F. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.

G. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.21 CUTTING AND FITTING

A. Cut and fit for chases. Coordinate with other sections of work to provide correct size, shape, and location.

B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.22 CLEANING

A. Remove excess mortar and mortar droppings.

B. Replace defective mortar. Match adjacent work.

C. Clean soiled surfaces with cleaning solution.

3.23 ENVIRONMENTAL REQUIREMENTS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
   2. Where 1 wythe of multi-wythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
      a. Protect sills, ledges, and projections from mortar droppings.
   2. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   3. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

3.24 PROTECTION

A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.

END OF SECTION

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SECTION 05 12 00
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
   3. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications including steel lintels and shelf angles not attached to structural-steel frame and other metal items not defined as structural steel.
   4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" and Section 099600 "High-Performance Coatings" for surface-preparation and priming requirements.

1.03 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.04 PERFORMANCE REQUIREMENTS

A. Construction: Refer to the Drawings for description of lateral load resisting system.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop and Erection Drawings: Show location, fabrication, and assembly of structural-steel components.
   1. Location of each piece or detail within the structure.
   2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
   3. Include embedment piece and setting drawings.
   4. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
   5. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
   6. Drawings submitted in multiple packages shall contain individual submittals complete with all applicable erection drawings, details, and piece drawings.
   7. Reproduction of Contract Documents is not permitted.
   8. Provide schedule for submittal of shop and erection drawings.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and fabricator

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural steel, including chemical and physical properties.

E. Product Test Reports: For the following if present on project:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.

2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

1.07 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Comply with applicable provisions of the following specifications and documents:
   1. AISC 303 as amended below:
      a. Section 3.2: Replace entire section with the following: “Requirements for structural steel including quantities, sizes, locations, arrangement, and details shall be shown or noted in the overall Contract Drawing package. Fabricator is responsible for incorporating all such information from structural, architectural, mechanical, and electrical drawings, as well as those of other disciplines.”
      b. Section 3.5: Remove all text after first sentence.
      c. Section 3.6: Replace entire section with the following: “When the fast-track project delivery system is selected, release of structural drawings shall constitute release for construction only if specifically noted as such on the drawing. Drawing indicated “preliminary” or “not for construction” shall not be used for detailing or construction except where the risk of any cost or delay associated with subsequent revisions to Contract Documents is accepted by the Owner, Contractor or Fabricator.”
      d. Section 4.4: Revise second sentence to read the following: “The shop and erection drawings shall be returned in accordance with the schedule defined in Division 1 of the project Specification. In the absence of such schedule, the Owner’s Designated Representative for Design shall return submittals within 14 calendar days of receipt from the Owner’s Designated Representative for Construction.”
   2. AISC 360.
   3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

F. Preinstallation Conference: Conduct conference at Project site.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

1.09 COORDINATION

A. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

PART 2 PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M unless indicated otherwise on Drawings.

B. Channels, Angles: ASTM A 36/A 36M unless indicated otherwise on Drawings.

C. Plate and Bar: ASTM A 36/A 36M unless indicated otherwise on Drawings.

D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade C, structural tubing.

E. Welding Electrodes: Comply with AWS requirements, 70 Series.
   1. Conform to Charpy V-Notch test requirements of AISC 360.
   2. Conform to Charpy V-Notch test requirements of AISC 341 for components included in the Seismic-Load-Resisting System.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. Use Tension-Control, High-Strength Bolt-Nut-Washer Assemblies whenever possible unless indicated otherwise.

B. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1 round head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
   1. Finish: Plain.

D. Steel Headed Stud Anchors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 55, weldable.
   1. Configuration: Straight
   2. Nuts: ASTM A 563 heavy-hex carbon steel.
   3. Plate Washers: ASTM A 36/A 36M carbon steel.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.
   5. Finish: Plain

F. Headed Anchor Rods: ASTM F 1554, Grade 55, weldable, straight.
   1. Nuts: ASTM A 563 heavy-hex carbon steel.
   2. Plate Washers: ASTM A 36/A 36M carbon steel.
   3. Washers: ASTM F 436, Type 1, hardened carbon steel.
   4. Finish: Plain.

G. Threaded Rods: ASTM A 36/A 36M.
   1. Nuts: ASTM A 563 heavy-hex carbon steel.
   2. Washers: ASTM A 36/A 36M carbon steel.
   3. Finish: Plain.

H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

I. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.

J. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.

K. Deformed Anchor Studs (DAS) / Deformed Bar Anchors (DBA): Made from ASTM A 108 low carbon steel, cold worked and deformed per ASTM A 496. Minimum yield stress = 60 ksi; minimum tensile strength = 80 ksi.

L. Rebar: Rebar used for welding shall meet the requirements of ASTM A-706. Minimum bend diameters per ACI 318.

M. Expansion Anchors, Screw Anchors, and Adhesive Anchors: Size and Manufacturer as indicated on Drawings. Complete assemblies with required rods, nuts, washers, and adhesive system as applicable. Installed in accordance with Manfacturer's installation instructions. Current ICC approval and published ICC Research Report required.
   1. Finish for use in conditioned environments free from potential moisture (interior): Plain or in accordance with Manufacturer's standard.
   2. Finish for use in exposed or potentially wet environments and for attachment of exterior cladding materials: Galvanized in conformance with ASTM A 153 or stainless steel, Series 300.

2.03 PRIMER

A. Primer: Where steel is to be field painted, provide fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.04 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
   1. Camber structural-steel members where indicated.
   2. Fabricate beams with rolling camber up.
   3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
   4. Mark and match-mark materials for field assembly.
   5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations, if applicable.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces. Do not enlarge bolt holes by burning.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning or SSPC-SP 3, "Power Tool Cleaning."

F. Steel Headed Stud Anchors and Deformed Anchor Studs / Deformed Bar Anchors: Prepare steel surfaces as recommended by manufacturer of anchors. Use automatic end welding of anchors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
   1. Cut, drill, thermal cut, or punch holes perpendicular to steel surfaces
   2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.

H. Splices: Splicing of members to obtain required lengths is not permitted without prior approval of structural Engineer-of-Record unless indicated on the Drawings.

I. Substitutions: Where exact sizes and weights indicated on Drawings are not readily available, secure approval of alternate sizes from Structural Engineer-of Record in time to prevent project delay.

2.05 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: As indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M **and AWS D1.8/D1.8M** for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.06 SHOP PRIMING

A. Shop prime steel surfaces except the following:
   1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
   2. Surfaces to be field welded, including top flange of beams to receive steel headed stud anchors.
   3. Surfaces to be high-strength bolted with slip-critical connections.
   4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
   5. Galvanized surfaces.
   6. Surfaces not otherwise indicated to be painted that are not exposed to view or weather in the final condition.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to either of the following specifications and standards:
   1. SSPC-SP 2, "Hand Tool Cleaning."
   2. SSPC-SP 3, "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
   2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection.

2.07 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
   1. Fill vent and drain holes in closed sections (HSS or Pipe) that will be exposed in the finished Work unless they will function as weep holes, by plugging with zinc solder and filing off smooth.
   2. Galvanize lintels and shelf angles located in exterior walls.

2.08 SOURCE QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
   1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
   1. Coordinate installation of non-structural steel items that load the temporarily supported steel frame such that temporary supports are adequate to resist all imposed loads.
   2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3. Do not apply permanent loading other than the weight to supported concrete slab-on-deck assemblies to composite beams and girders until concrete has achieve 75 percent of its design strength without prior approval of structural Engineer-of-Record.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.

B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Weld plate washers to top of baseplate where indicated on Drawings.
   3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   4. Clean and moisten surfaces to receive grout. Immediately remove any remaining free water. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature of 70° F when structure is completed and in service.

E. Splice members only where indicated.
   1. Fasten splices in compression after bearing surface have been brought into contact. Close all gaps greater than 1/16” by driving non-tapered mild steel shims full depth of bearing surface along full length of gap.

F. Do not use thermal cutting during erection unless approved by Structural Engineer-of-Record. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Steel Headed Stud Anchors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

3.04 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
   1. Joint Type: As indicated on Drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
   2. Remove backing bars or runoff tabs where indicated on Drawings, back gouge, and grind steel smooth.

3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

3.05 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings.

3.06 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.

B. Touchup Painting: Cleaning and touchup painting are specified in Section 099113 "Exterior Painting" Section 099123 "Interior Painting and Section 099600 “High Performance Coatings”

END OF SECTION

SECTION 05 31 00
STEEL DECKING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Roof deck.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

1.05 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

B. FM Global Listing: Provide steel roof deck evaluated by FM Global and listed in its "Approval Guide, Building Materials".

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.02 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   1. ASC Profiles, Inc.; a Blue Scope Steel company.
   2. Canam United States; Canam Group Inc.
   3. CMC Joist & Deck.
   4. Consolidated Systems, Inc.; Metal Dek Group.
   5. Cordeck.
   6. DACS, Inc.
   7. Epic Metals Corporation.
   8. Marlyn Steel Decks, Inc.
   9. New Millennium Building Systems, LLC.
   10. Nucor Corp.; Vulcraft Group.

11. Roof Deck, Inc.
12. Valley Joist; Subsidiary of EBSCO Industries, Inc.
13. Verco Manufacturing Co.
14. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
1. Galvanized-Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), grade, thickness and profile as indicated, zinc coating. Use at exterior locations not indicated to be painted and exposed to view.
2. Span Condition: As indicated.
3. Side Laps: Overlapped.

2.03 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile indicated but not less than recommended by SDI Publication No. 31 for overhang and slab depth.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Weld Washers: Uncoated steel sheet, shaped to fit deck rib, 0.0747 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

H. Galvanizing Repair Paint: ASTM A 780.

I. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. When steel headed stud anchors are to be welded through metal deck and/or corrugated metal forming, the top flange of beams to receive such anchors shall be unpainted and free of debris prior to installation of the deck and/or forming.

3.02 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations. Obtain prior written approval from Structural Engineer-of-Record before installing shoring.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
   1. Refer to Drawings for opening sizes requiring reinforcement and typical reinforcement options.
   2. Miscellaneous openings not shown on the Drawings such as those required for vents, risers, conduits, etc. shall be cut and reinforced if necessary, by the trade requiring the opening.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck with prior written approval of Structural Engineer-of-Record. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 ROOF-DECK INSTALLATION

A. Fasten roof-deck panels as indicated on drawings. Provide weld washer at each location where uncoated deck of thickness 0.028 inches or less is being fastened to supporting members by welding.

B. End Bearing: Install deck ends over supporting frame with a minimum end bearing length as indicated, with end joints as follows:
   1. End Joints: Lapped as indicated.

C. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
   1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

A. Testing and Inspection: As indicated on Drawings.

3.05 PROTECTION

A. Galvanizing Repairs: Where deck is exposed to weather or moisture, prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Repair Painting: Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.
   1. Do not use deck units for storage or as a working platform until permanently secured in position.
   2. Contractor shall assure that completed deck is not damaged by use as a runaway, storage of materials or subsequent work.
   3. Contractor shall assure that construction loads are not allowed which exceed the safe carrying capacity of the deck.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Exterior non-load-bearing wall framing.
   2. Ceiling and exterior soffit joist framing

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed metal framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. As indicated
   3. Design framing systems to provide for movement of framing members without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
      a. As indicated

B. Cold-Formed Steel Framing, General: Design according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Headers: Design according to AISI's "Standard for Cold-Formed Steel Framing - Header Design."
   2. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.

1.04 SUBMITTALS

A. Product Data: For each type of cold-formed metal framing product and accessory indicated.

B. Shop Drawings: Provide ¼" = 1'-0" scale elevations of all walls and plans of all soffits comprised of cold-formed metal framing. Show layout, spacings, sizes, thicknesses, and types of cold-formed metal framing; fabrication; and fastening and anchorage details, including mechanical fasteners. Show reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.
   1. For cold-formed metal framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Welding certificates.

D. Product Test Reports: From a qualified testing agency, unless otherwise stated, indicating that each of the following complies with requirements, based on evaluation of comprehensive tests for current products:
   1. Vertical deflection clips.
   2. Horizontal drift deflection clips
   3. Stiff Clips

1.05 QUALITY ASSURANCE

A. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

B. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

C. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

D. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

E. Fire-Test-Response Characteristics: Where indicated, provide cold-formed metal framing identical to that of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

F. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."
   1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
   2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect cold-formed metal framing from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store cold-formed metal framing, protect with a waterproof covering, and ventilate to avoid condensation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering cold-formed metal framing that may be incorporated into the Work include, but are not limited to, the following:
   1. Allied Studco.
   2. AllSteel Products, Inc.
   3. California Expanded Metal Products Company.
   4. Clark Steel Framing.
   5. Consolidated Fabricators Corp.; Building Products Division.
   6. Craco Metals Manufacturing, LLC.
   7. Custom Stud, Inc.
   8. Dale/Incor.
   9. Design Shapes in Steel.
   10. Dietrich Metal Framing; a Worthington Industries Company.
   11. Formetal Co. Inc. (The).
   12. Innovative Steel Systems.
   13. MarinoWare; a division of Ware Industries.
   14. Quail Run Building Materials, Inc.
   15. SCAFCO Corporation.
   16. Southeastern Stud & Components, Inc.
   17. Steel Construction Systems.
   18. Steeler, Inc.
   19. Super Stud Building Products, Inc.
   20. United Metal Products, Inc.

2.02 MATERIALS

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: ST33H for studs 18 gauge and lighter, ST50H for studs heavier than 18 gauge.
   2. Coating: G90.

B. Steel Sheet for Vertical Deflection, Stiff, Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: 50, Class 1 or 2.
   2. Coating: G90.
   3. Gauge: 14 gauge minimum

2.03 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch
   2. Minimum Flange Width: 1-5/8 inches
   3. Section Properties: As required

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs.
   2. Minimum Flange Width: 1-1/4 inches

C. Vertical Deflection Clips: Manufacturer's standard bypass and head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
      a. Dietrich Metal Framing; a Worthington Industries Company.
      b. MarinoWare, a division of Ware Industries.
      c. SCAFCO Corporation
      d. The Steel Network, Inc.

D. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure.

E. Stiff Clips: Clip capable of supporting design loads indicated through positive mechanical attachment to the stud web. Maximum deflection of the clip/stud assembly under design loads shall be the smaller of 1/8” or the elastic limit load.

2.04 CEILING AND EXTERIOR SOFFIT JOIST FRAMING

A. Steel Ceiling and Soffit Joists: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch
   2. Flange Width: 1-5/8 inches, minimum.
   3. Section Properties: As required.

2.05 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.

5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.06 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36, zinc coated by hot-dip process according to ASTM A 123.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A 153/A 153M, Class.

C. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing per ASTM E 488 conducted by a qualified independent testing agency.

D. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing per ASTM E 1190 conducted by a qualified independent testing agency.

E. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.07 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or DOD-P-21035.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C 1107, with fluid consistency and 30-minute working time.

D. Shims: Load bearing, high-density multimonomer plastic, nonleaching.

E. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.08 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.
   1. Fabricate framing assemblies using jigs or templates.
   2. Cut framing members by sawing or shearing; do not torch cut.
   3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.
   4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
   2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.

C. Install load bearing shims or grout between the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations to ensure a uniform bearing surface on supporting concrete or masonry construction.

D. Install sealer gaskets to isolate the underside of wall bottom track or rim track and the top of foundation wall or slab at stud or joist locations.

3.03 INSTALLATION, GENERAL

A. Cold-formed metal framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until

entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion and control joints with cold-formed metal framing. Independently frame both sides of joints.

H. Install insulation, specified in Division 07 Section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings.

J. Erection Tolerances: Install cold-formed metal framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.04 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to track, unless otherwise indicated. Space studs as follows:
   1. Maximum Stud Spacing: 24 inches.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
   1. Connect vertical deflection clips to bypassing and infill studs and anchor to building structure.
   2. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.05 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.06 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 50 00
METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Shop fabricated steel items.
   1. Steel lintels.
   2. Ledge Angles, Shelf Angles, Channels, and Plates Not Attached to Structural Framing.
   3. Interior roof access ladder.

1.02 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.

B. Section 04 20 00 - Unit Masonry: Placement of metal fabrications in masonry.

C. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.

D. Section 05 51 33 - Metal Ladders.

E. Section 06 10 00 - Rough Carpentry: Wood composite components associated with trash enclosure and generator enclosure gates.

F. Section 09 90 00 - Painting and Coating: Field Painting.

1.03 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2014.

B. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).

C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.

D. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates 2013.

E. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2014.

F. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2013.

G. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2015.

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

I. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2009 (Reapproved 2015).

J. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2014.

K. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2013.

L. SSPC-PA 1 - Shop, Field, and Maintenance Painting of Steel; 2004.

M. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

N. SSPC-SP 2 - Hand Tool Cleaning 1982 (Ed. 2004).

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.

C. Welders' Certificates: Submit certification for welders employed on the project, verifying AWS qualification within the previous 12 months.

D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

A. Design metal fabrications under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

1.06 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

A. Steel Sections: ASTM A36/A36M.

B. Plates: ASTM A283/A283M.

C. Slotted Channel Framing: ASTM A653/A653M, Grade 33.

D. Slotted Channel Fittings: ASTM A1011/A1011M.

E. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, plain.

F. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A325, Type 3; with hex nuts, ASTM A563, Grade C3; and, where indicated, flat washers.

G. Machine Screws: ASME B18.6.3.

H. Lag Screws: ASME B18.2.1.

I. Wood Screws: Flat head, ASME B18.6.1.

J. Plain Washers: Round, ASME B18.22.1.

K. Lock Washers: Helical, spring type, ASME B18.21.1.

L. Shop and Touch-Up Primer - Interior Exposure: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

M. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.02 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

E. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

F. Form exposed work with accurate angles and surfaces and straight edges.

G. Weld corners and seams continuously to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosionresistance of base metals.

2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing.

H. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

I. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

J. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

K. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

L. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.03 FABRICATED ITEMS

A. Ladders: Steel; in compliance with ANSI A14.3; with mounting brackets and attachments; prime paint finish.
1. Side Rails: 3/8 x 2 inches members spaced at 20 inches.
2. Rungs: one inch diameter solid round bar spaced 12 inches on center.
3. Space rungs 7 inches from wall surface.
4. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
5. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
6. Ladder Climbing Safety System: Provide each ladder with a ladder climbing safety system.
a. Basis-of-Design: Subject to compliance with requirements, provide CAI Safety Systems: Ladder Cable Fall Arrest for Roof Hatch Ladder.

B. Lintels: As detailed; galvanized finish and high performance coating as indicated in drawings.

C. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; factory-applied, rust-inhibiting thermoset acrylic enamel finish.
1. Manufacturer: Unistrut.
2. Design slotted channel framing system to meet load and deflection requirements required by equipment supplier. Include supplemental and incidental framing and attachments to existing structure as necessary to meet those requirements.
3. Size of Channels: 1-5/8 by 1-5/8 inches, 14 gage minimum, or as required for loading by Design/Build engineer.
4. All hardware to be electro-galvanized.

2.04 ACCESSORY PRODUCTS

A. High-strength (6,000 to 10,000 psi), Non-Shrink, Non-Metallic Grout: Provide premixed, factory-packaged, non-staining, non-corrosive, non-gaseous grout complying with ASTM C1107. Provide grout specifically recommended by manufacturer for exterior applications.

2.05 FINISHES, INTERIOR EXPOSURE

A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
1. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."

B. Shop Priming: Apply one coat of Universal Shop Primer to uncoated surfaces of metal fabrications, except where indicated to receive sprayed-on fireproofing.

2.06 FINISHES, EXTERIOR EXPOSURE

A. Duplex System: Hot-dip galvanize and apply shop primer compatible with both galvanizing and the top coats to be field applied by Division 9 Section High Performance Coating. Comply with all recommendations of manufacturer's product data for the compatible zinc-rich shop primer, including preparation.
   1. Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
      a. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Galvanizing: Hot-dip galvanize items exposed to the exterior to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.
   3. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.
   4. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.
   5. For newly galvanized surfaces, a water-based emulsifier can be used to remove contaminants.
   6. After cleaning, thoroughly rinse the surface clean, with hot water and allow complete drying before profiling.
   7. Profile Galvanized surfaces, free of protrusions and slightly roughened to provide an anchor profile to allow a good mechanical bond. Take care to remove as little zinc as possible.
   8. Apply compatible zinc-rich shop primer to galvanized surfaces of metal fabrications.

2.07 FABRICATION TOLERANCES

A. Squareness: 1/8 inch maximum difference in diagonal measurements.

B. Maximum Offset Between Faces: 1/16 inch.

C. Maximum Misalignment of Adjacent Members: 1/16 inch.

D. Maximum Bow: 1/8 inch in 48 inches.

E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

A. Clean and strip primed steel items to bare metal where site welding is required.

3.03 INSTALLATION

A. Install items plumb and level, accurately fitted, free from distortion or defects.

B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

C. Obtain approval prior to site cutting or making adjustments not scheduled.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rough opening framing for doors, windows, and roof openings.

B. Roof-mounted curbs.

C. Preservative treated wood materials.

D. Fire retardant treated wood materials.

E. Miscellaneous framing and sheathing.

F. Concealed wood blocking, nailers, and supports.

G. Miscellaneous wood nailers, furring, and grounds.

1.02 RELATED REQUIREMENTS

A. Section 05 50 00 - Metal Fabrications: Miscellaneous steel connectors and support angles for wood framing.

B. Section 07 62 00 - Sheet Metal Flashing and Trim: Sill flashings.

1.03 REFERENCE STANDARDS

A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2009.

B. ASTM D2898 - Standard Test Methods for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing 2010.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels 2010.

E. PS 20 - American Softwood Lumber Standard 2010.

F. SPIB (GR) - Grading Rules 2014.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide technical data on wood preservative materials and application instructions.

C. Research/ Evaluation Reports: For the following, show compliance with the building codes in effect for the Project:
   1. Wood preservative treated wood.
   2. Fire retardant treated wood.
   3. Metal framing anchors.

D. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.

B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Correct defective work within a two-year period commencing on Date of Substantial Completion.

C. Provide five year manufacturer warranty for Work as completed as part of this Section.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
   1. Species: Douglas Fir-Larch, unless otherwise indicated.
   2. If no species is specified, provide species graded by the agency specified; if no grading agency is specified, provide lumber graded by grading agency meeting the specified requirements.
   3. Grading Agency: Grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee at www.alsc.org, and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
   4. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

B. Lumber fabricated from old growth timber is not permitted.

C. Provide composite wood products that do not contain added urea formaldehyde.

D. Lumber: DOC PS 20 and applicable rules of grading agencies indicated, if no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece or omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

E. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

A. Framing Other Than Non-Load-Bearing Interior Partitions:
   1. No. 2 grade. Sizes: Nominal sizes as indicated on drawings, S4S.
   2. Moisture Content: S-dry or MC19.
   3. Species: Any allowed under listed referenced grading rules.
      a. Hem-fir (north); NLGA.
      b. Southern pine; SPIB.
      c. Douglas fir-larch; WCLIB or WWPA.
      d. Mixed southern pine; SPIB.
      e. Spruce-pine-fir; NLGA.
      f. Douglas fir-south; WWPA.
      g. Hem-fir; WCLIB or WWPA.
      h. Douglas fir-larch (north); NLGA.
      i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.

B. Non-Load Bearing Interior Partitions: Standard Stud or No.3 grade
   1. Applications: Interior Partitions not indicated as load-bearing.
   2. Species:
      a. Mixed southern pine; SPIB.
      b. Northern species; NLGA
      c. Eastern softwoods; NeLMA.
      d. Western woods; WCLIB or WWPA

C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
   1. Lumber: S4S, No. 2 or Standard Grade.
   2. Boards: Standard or No. 3.

2.03 FACTORY WOOD TREATMENT

A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire test-response characteristics specified as determined by testing identical products per test method

indicated by a qualified testing agency.

B. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
   1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.

C. Fire Retardant Treatment:
   1. General: Comply with performance requirements of American Wood Protection Association, AWPA U1-10.
   2. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
      a. Exterior Type: AWPA U1, Category UCFB, Commodity Specification H, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes both before and after accelerated weathering test performed in accordance with ASTM D2898.
         1) Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
         2) Treat all exterior rough carpentry items.
         3) Do not use treated wood in direct contact with the ground.
         4) Products and Applications:
            (a) Dricon FRX at: Exterior Applications:
            (b) Interior areas with a relative humidity over 50%.
            (c) Concealed blocking within exterior walls.
            (d) Other areas specifically noted on drawings.
            (e) Note: Do “Not” use Dricon FRX where enclosed in roofing assemblies!
      b. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
         1) Kiln dry wood after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood.
         2) All interior rough carpentry items are to be fire retardant treated.
         3) Treat rough carpentry items as scheduled.
         4) Use Interior Type A, High Temperature (HT) for enclosed roof framing, framing in attic spaces, and where indicated.
         5) Do not use treated wood in applications exposed to weather or where the wood may become wet.
         6) Products and Applications:
            (a) Dricon FRT at: Interior Applications and at the following other applications:
            (b) Concealed blocking within parapets.
            (c) Roof construction, rooftop equipment bases and support curbs.

2.04 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interiorconstruction not in contact with the ground, Use Category UC3b for exterior constructioncontact with the ground, and Use Category UC4a for items in contact with the ground, not in
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing noarsenic or chromium. Do not use inorganic boron (SBX) for sill plates.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not usematerial that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Boardof Review

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similarmembers in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members incontact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exteriormasonry or concrete walls.
   4. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
   5. Wood floor plates that are installed over concrete slabs-on-grade.

2.05 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.
   3. Furring.

B. For items of dimension lumber size, provide Construction or No. 2.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine; No. 2 grade; SPIB.
   2. Eastern softwoods; No. 2 Common grade; NeLMA.
   3. Northern species; No. 2 Common grade; NLGA.
   4. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

2.06 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: DOC PS 1, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.07 ACCESSORIES

A. Fasteners and Anchors:
   1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
   2. Provide fasteners approved for use with fire rated material.
   3. Screws for fastening to metal framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended for material being fastened.
   4. Drywall Screws: Bugle head, hardened steel, power driven type, length three times thickness of sheathing.

B. Anchors: Toggle bolt type for anchorage to hollow masonry.
   1. Power-Driven Fasteners: NES NER-272.
   2. Bolts: Steel bolts complying with ASTM A 325; with ASTM A 563 hex nuts and, where indicated, flat washers.

C. Sill Gasket on Top of Foundation Wall: 1/4 inch thick, plate width, closed cell plastic foam from continuous rolls.

D. Sill Flashing: As specified in Section 07 62 00.

PART 3 EXECUTION

3.01 PREPARATION

A. Where wood framing bears on cementitious foundations, install full width sill flashing continuous over top of foundation, lap ends of flashing minimum of 4 inches and seal.

B. Install sill gasket under sill plate of framed walls bearing on foundations; puncture gasket cleanly to fit tightly around protruding anchor bolts.

3.02 INSTALLATION - GENERAL

A. Select material sizes to minimize waste.

B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.

3.03 BLOCKING, NAILERS, AND SUPPORTS

A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.

B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.

C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.

D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.

E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.

F. Nail according to the minimum requirements of the "Recommended Nailing Schedule" for common nails published in the current NFPA "Manual for House Framing" or as per Structural Engineer recommendations.

3.04 ROOF-RELATED CARPENTRY

A. Coordinate installation of roofing carpentry with deck construction, framing of roof openings, and roofing assembly installation.

B. Provide wood curb at all roof openings except where prefabricated curbs are specified and where specifically indicated otherwise. Form corners by alternating lapping side members.

3.05 SITE APPLIED WOOD TREATMENT

A. Apply preservative treatment compatible with factory applied treatment at site-sawn cuts, complying with manufacturer's instructions.

B. Allow preservative to dry prior to erecting members.

3.06 TOLERANCES

A. Framing Members: 1/4 inch from true position, maximum.

B. Surface Flatness of Floor: 1/8 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

C. Variation from Plane, Other than Floors: 1/4 inch in 10 feet maximum, and 1/4 inch in 30 feet maximum.

3.07 CLEANING

A. Waste Disposal: See Section 01 74 19 - Construction Waste Management and Disposal.
   1. Comply with applicable regulations.
   2. Do not burn scrap on project site.
   3. Do not burn scraps that have been pressure treated.
   4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or “waste-to-energy” facilities.

B. Do not leave wood, shavings, sawdust, etc. on the ground or buried in fill.

C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

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SECTION 06 20 00
FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Finish carpentry items.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

B. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.03 REFERENCE STANDARDS

A. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014.

B. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0 2016.

C. BHMA A156.9 - American National Standard for Cabinet Hardware 2010.

D. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data:

C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.

D. Samples: Submit two samples of wood trim ____ inch long.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect from moisture damage.

B. Handle materials and products to prevent damage to edges, ends, or surfaces.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.

C. Interior Woodwork Items:
   1. Chair rail.

2.02 PLASTIC LAMINATE MATERIALS

A. Plastic Laminate: NEMA LD 3; color as selected by Architect; textured, low gloss finish.

2.03 ACCESSORIES

A. Adhesive: Type recommended by fabricator to suit application.

2.04 HARDWARE

A. Hardware: Comply with BHMA A156.9.

2.05 FABRICATION

A. Shop assemble work for delivery to site, permitting passage through building openings.

B. Cap exposed plastic laminate finish edges with material of same finish and pattern.

C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.

D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.

2.06 SHOP FINISHING

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify adequacy of backing and support framing.

B. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

A. Set and secure materials and components in place, plumb and level.

B. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.

END OF SECTION

SECTION 06 83 16
FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fiberglass reinforced plastic panels.

1.02 REFERENCE STANDARDS

A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics 2010.

B. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of Barcol Impressor 2013a.

C. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2012.

D. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels 2012.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Samples: Submit two samples [____by____] inch in size illustrating material and surface design of panels.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fiberglass Reinforced Plastic Panels:
   1. Crane Composites, Inc; _____: www.cranecomposites.com/#sle.
   2. Marlite, Inc; _____: www.marlite.com/#sle.
   3. Nudo Products, Inc; _____: www.nudo.com/#sle.
   4. Panolam Industries International, Inc; Panolam FRP: www.panolam.com/#sle.
   5. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:
   1. Panel Size: 4 by 8 feet.
   2. Panel Thickness: 0.10 inch.
   3. Surface Design: Embossed.
   4. Color: White.
   5. Attachment Method: Adhesive only, sealant joints, no trim.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.
   1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions and substrate flatness before starting work.

B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

A. Install panels in accordance with manufacturer's instructions.

B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.

C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.

D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.

E. Install panels with manufacturer's recommended gap for panel field and corner joints.

F. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

G. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 11 13
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bituminous dampproofing.

1.02 RELATED REQUIREMENTS

A. Section 07 21 00 - Thermal Insulation: Rigid insulation board used as protection board.

1.03 REFERENCE STANDARDS

A. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing 2011.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING

A. Bituminous Dampproofing: Cold-applied water-based emulsion; asphalt with mineral colloid or chemical emulsifying agent; with or without fiber reinforcement; asbestos-free; suitable for application on vertical and horizontal surfaces.
   1. Composition - Vertical Application: ASTM D1227/D1227M Type III or ASTM D1187/D1187M Type I.
   2. Composition - Horizontal and Low-Slope Application: ASTM D1227/D1227M Type II or III.
   3. VOC Content: Not more than permitted by local, State, and federal regulations.
   4. Applied Thickness: 1/16 inch, minimum, wet film.
   5. Products:
      a. W. R. Meadows, Inc; Sealmastic Emulsion Type I (spray-grade): www.wrmeadows.com/#sle.
      b. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BITUMEN MATERIALS

A. Cold Asphaltic Type:
   1. Bitumen: Emulsified asphalt, ASTM D1227/D1227M, with fiber reinforcement other than asbestos, Type II, Class 1 or 2.
   2. Asphalt Primer: ASTM D41/D41M, compatible with substrate.

END OF SECTION

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SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Foam Board insulation at cavity wall construction, perimeter foundation wall, underside of floor slabs, and exterior wall behind rain screen wall finish.

B. Rock-wool-fiber board insulation.

C. Spray-applied insulations:
   1. Cellulosic.
   2. Polyurethane foam.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Installation requirements for board insulation over steep slope roof sheathing or roof structure.

B. Section 07 84 00 - Firestopping: Fire safing insulation.

C. Section 07 42 13 - Metal Wall Panels.

D. Section 09 51 00 - Acoustical Ceilings: Insulation above ceiling systems.

E. Division 22 and 23 Sections: Duct insulation, equipment insulation and pipe insulation.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus 2010.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications 2013.

C. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation 2015a.

D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation 2014.

E. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2014.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2014.

H. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components 2012.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.

C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source.

1.06 FIELD CONDITIONS

A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Insulation at Perimeter of Foundation: Extruded polystyrene board.

B. Insulation Inside Masonry Cavity Walls: Polyisocyanurate board.

C. Insulation Inside Rain Screen Walls: Polyisocyanurate board.

D. Spray-applied polyurethane foam insulation: Applications where indicated on Drawings.

E. Insulation at top of metal framed wall and fluted metal deck: Rock-wool-fiber board insulation.

F. Where detailed on drawings: rock-wool-fiber board insulation and incidental spray applied acoustical/thermal insulation.

2.02 FOAM BOARD INSULATION MATERIALS

A. Extruded Polystyrene (XPS) Board Insulation: Complies with ASTM C578 with either natural skin or cut cell surfaces.
   1. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   2. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
   3. Board Size: 48 x 96 inch.
   4. Board Thickness: See drawings for thickness.
   5. Board Edges: Square.
   6. Type and Water Absorption: Type IV, 0.3 percent by volume, maximum, by total immersion.
   7. Thermal Conductivity (k-factor or u-value per inch) at 25 degrees F: 0.20.
   8. Compressive Resistance: 25 psi.
   9. Products:
      a. Owens Corning Corp: www.owenscorning.com.
      b. Kingspan Insulation LLC; GreenGuard XPS Type IV, 25 psi: www.kingspan.com/#sle.

B. Polyisocyanurate (ISO) Board Insulation with Facers Both Sides: Rigid cellular foam, complying with ASTM C1289.
   1. Classifications:
      a. Type I: Faced with aluminum foil on both major surfaces of core foam.
         1) Compressive Strength: 25 psi, minimum.
   2. Flame Spread Index (FSI): Class A - 0 to 25, when tested in accordance with ASTM E84.
   3. Faces: 1.0 mil thick reflective aluminum facers on both sides.
   4. Surface Burning Characteristics (at a maximum thickness of 4.25 inches.) Comply with current IBC and NFPA requirements for foam plastic insulation for use in non-combustible construction, meeting the following criteria:
      a. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
      b. Smoke Developed Index (SDI): 450 or less, when tested in accordance with ASTM E84.
      c. Complies with fire resistance requirements indicated on drawings as part of an exterior non-load-bearing exterior wall assembly when tested in accordance with NFPA 285.
      d. The panels are classified as a (Class 1)(Class A) Interior Finish Material.
   5. Density: Nominal 2 pcf.
   6. Water Vapor Transmission (ASTM E96): less than 0.1 perm.

7. Water Absorption by Volume (ASTM C209): less than 1 percent.
8. Board Size: 48 inch by 96 inch.
9. Thickness: See drawings for thicknesses.
10. Thermal Resistance: Minimum R-value per inch of 6.3.
11. Board Edges: Shiplap on long edges.
12. Basis of Design: Dupont Thermax ci Foam Insulation.
    a. ICC-ES 1659.
    b. UL Classified, see Classification Certificate 1256. Calif. Std. Reg. # CA T383.
    c. Other acceptable manufacturers: must comply with NFPA 285.
        1) Atlas Wall CI Board, division of Atlas Roofing Corporation; EnergyShield PRO: www.atlasroofing.com.
        2) Hunter Panels, LLC; Xci Class A Foil: www.hunterxci.com.
        3) Rmax Inc; ECOMAXci FR: www.rmax.com/#sle.
        4) NO SUBSTITUTIONS: All of the product options specified for use as wall system components have been carefully selected for compatibility with each other for compliance with NFPA-285, as documented by Third Party Selection Charts. For this reason, substitution requests are not permitted here.
13. Accessories for Polyisocyanurate Board Installation:
    a. Penetration and Gap Filler.
        1) The Dow Chemical Company; GREAT STUFF PRO™
            (a) Use for joints between boards and at penetrations where gap size is between 1/4-inch to 2-inches.
    b. Exterior Insulation Joint Treatment.
        1) The Dow Chemical Company; LIQUIDARMOR™ CM spray flashing and sealant.
            (a) Use for gaps less than 1/4-inch.
        2) The Dow Chemical Company; LIQUIDARMOR™ LT flexible single component silicone flashing.
            (a) Use for gaps greater than 1/4-inch
    c. Always use both Penetration and Gap Filler prior to sealing joint with Exterior Insulation Joint Treatment (as this is best practice installation.)
14. Associated foam sealant for insulation joints between insulation: DOW, GREAT STUFF™.
    a. Minimal expansion polyurethane insulating foam sealant that fills, seals and insulates gaps up to 1/2 inch. It expands to take the shape of cracks and voids to form a permanent, airtight, and water-resistant bond that eliminates unwanted airflow and helps reduce condensation.
    b. Forms a permanent weather-tight seal to minimize drafts for gaps, cracks and holes less than ½ inch.
    c. Exceptional adhesion to.
    d. Interior or exterior use.
    e. Airtight, water-resistant.
    f. Tack free in 6 minutes; Trims in 30 minutes.
    g. Cream colored foam.
    h. Cures rigid.
    i. UL Classified & complies with CCMC 13074-R.

2.03 FIBERBOARD INSULATION MATERIALS

A. Mineral Fiberboard Insulation: Rigid mineral fiber, in accordance with ASTM C612.
    1. Facing: Black non-woven mat.
    2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
    3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
    4. Board Size: 48 by 48 inch.
    5. Board Thickness: 1 inch.
    6. Board Edges: Square.

7. Thermal Conductivity (k-factor): BTU inch/hr sq ft degrees F of 0.26 per inch at 75 degrees F when tested in accordance with ASTM C518.
8. Maximum Density: 8 pounds per cubic foot, nominal.
9. Thermal Resistance: R of 4.2 per inch.
10. Products:
    a. Rockwool – Cavityrock.
    b. Owens Corning, Thermafiber – Rain Barrier HC.

B. Mineral Fiberboard Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or ASTM C553; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
1. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
2. Board Size: 16 by 48 inches.
3. Thermal Resistance: R of ____ per inch.
4. Products:
    a. Johns Manville; CladStone ___ Water & Fire Block Insulation: www.jm.com/#sle.
    b. Johns Manville; MinWool Safing: www.jm.com/#sle.
    c. Johns Manville; MinWool ___ Curtainwall: www.jm.com/#sle.
    d. ROCKWOOL (ROXUL, Inc); CAVITYROCK: www.rockwool.com/#sle.
    e. Thermafiber, Inc; RainBarrier ___: www.thermafiber.com/#sle.
    f. Thermafiber, Inc; FireSpan ___: www.thermafiber.com/#sle.
    g. Thermafiber, Inc; Safing: www.thermafiber.com/#sle.
    h. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 SPRAY-APPLIED POLYURETHANE FOAM INSULATION

A. Basis of Design:
1. Manufacturer: Icynene Inc.
2. Product: ProSeal LE, commercial.
3. Description: The polyurethane foam is produced in the field by combining polymeric isocyanurate (A) component and a resin (B) component.
4. Comply with ICC–ES ESR 3500.
    a. Appropriate for Construction Type 1.
    b. Tested for NFPA 285 compliance for project wall system designs.
    c. Class-I spray foam per ASTM E 84
        1) Flame spread: 25 maximum.
        2) Smoke developed: 450 maximum.
5. Tested for NFPA 285 compliance for project wall system designs.
6. Closed-cell performance requirements:
    a. Qualifies as Class II vapor retarder at 1.5-inch thickness.
    b. Core Density: 2.4 lb/ft³.
    c. Aged R-value per inch: 7.1

B. Acceptable manufacturers if compliant with requirements:
1. BSAF Corporation.
2. Carlisle Spray Foam Insulation.
3. Dow Chemical Incorporated.
4. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 ACCESSORIES

A. Insulation Fasteners: Impaling clip of unfinished steel with washer retainer and clips, to be adhered to surface to receive insulation, length to suit insulation thickness and substrate, capable of securely and rigidly fastening insulation in place.

B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Provide continuity of thermal barrier at building enclosure elements.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

3.03 BOARD INSTALLATION AT EXTERIOR WALLS

A. Install boards horizontally on walls.
   1. Place boards to maximize adhesive contact.
   2. Install in running bond pattern.
   3. Butt edges and ends tightly to adjacent boards and protrusions.
   4. Place impale fastener locking discs. Secure impale fasteners to substrate at following frequency: Six (6) Per insulation board.

B. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.

C. Seal board joints and gaps with Penetration and Gap Filler and treat joints with Manufacturer's recommended exterior insulation joint sealant.
   1. Seal around penetrations using Penetration and Gap Filler material.
   2. Maintain continuity of air barrier by sealing the roof/wall juncture with Roof/Wall Juncture Sealing material.

3.04 PROTECTION

A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

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SECTION 07 23 00
THERMAL AND AIR BARRIER WALL SYSTEM

PART 1GENERAL

1.01 SUMMARY

A. Provide a thermal and air barrier wall system for exterior cold-formed metal wall assemblies. Work includes:
   1. Provide exterior wall insulation.
   2. Seam treatment.

1.02 SYSTEM DESCRIPTION

A. Furnish and install an exterior wall system that effectively controls thermal, air and water performance and provides continuity of the building envelope enclosure. The system shall include the following:
   1. Insulated sheathing secured to the exterior of the metal wall framing assembly.
   2. Spray polyurethane foam applied to the interior wall cavity.
   3. Joint, penetration and gap sealing material for sealing component joints, penetrations through the wall system and gaps between the building envelope enclosure components and wall opening frames.
   4. Performance Characteristics:
      a. Thermal performance:
         1) Exterior insulation: ASTM C518, Stabilized R-value of 6.5 per inch of thickness with a minimum six month exposure capability to outdoor elements and 15 year thermal warranty.
      b. Air barrier performance: When tested in accordance with ASTM E2357, at a test pressure of not less than 6.24 psf, air infiltration shall not exceed 0.04 cfm per square foot (0.2 L/s*m2) of fixed wall area. Testing should be conducted at positive and negative sustained wind loading of 12.5psf (600Pa) for one-hour duration in each direction, pressure cycling of the wall at 2000 cycles in both the positive and negative direction, ending with wind gust loading at 25psf.
      c. Water penetration: When tested in accordance with ASTM E331, no uncontrolled water penetration shall occur at a minimum differential pressure of 6.24 psf for minimum test duration of 2hrs.
      d. Mold resistance: Thermal wall and air barrier system components shall provide non-food source for fungal growth.
   5. Code Compliance: Exterior wall system and component materials shall comply with the following requirements:
      a. Exterior Insulation:
         1) Class 1 (
         2) Fire Performance Evaluation as a component of an NFPA 285 approved wall assembly per the requirements of the International Building Code.
   6. Fire Resistance:
      a. System complies with NFPA 285 [2006]: Standard Method of Test for the Evaluation of Flammability Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components Using the Intermediate-Scale, Multistory Test Apparatus.
      b. Fire-stopping measures, per code, should be included at the floor line in the stud cavity when the wall assembly extends beyond the edge of the floor line.

PART 2 PRODUCT

2.01 FOAM-ON-STRUCTURE WALL INSULATION SYSTEM

A. Exterior Insulation: Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4 mil gray front facer acrylic-coated aluminum on one side and 1.25 mil embossed aluminum on the back side, complying with ASTM C1289 and meeting the following physical properties:
   1. ASTM C1289 Type 1, Class 1.
   2. Compressive Strength (ASTM D1621): 25 psi, minimum.

3. Long-Term Thermal Resistance (ASTM C518, measured at Mean Temp of 75F): R-6.5 per 1 inch of thickness with 15 year thermal warranty.
4. Flexural Strength (ASTM C203): Minimum 40 psi.
5. Water Absorption (ASTM C209): Maximum.1.0 percent by volume.
6. Water Vapor Permeance (ASTM E96): <0.3 perms.
7. Maximum Use Temperature: 250 degrees F.
8. Acceptable Products: The Dow Chemical Company “THERMAX™ XARMOR ci Exterior Insulation.”
    a. Panel Size: 4’-0” wide x 8’-0” long, square edge, shiplap panels.
    b. Thickness and Stabilized R-Value: ~~2 inch thickness, R-13~~. **3 inch thickness, R-19 minimum. [RFI-003]**
9. Accessories:
    a. Fasteners: Provide insulated sheathing manufacturer’s recommended organic-polymer or other corrosion-protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.
        1) Acceptable Products: Wind-lock Corporation “CI-Lock Steel Series Selection” with 1-3/4 inch diameter high-grade plastic washers.
    b. Facer Repair Flashing: Provide board insulation manufacturer's recommended flashing for repair of damaged board insulation facer.
        1) Basis-of-Design Product: Subject to compliance with requirements, provide DuPont LiquidArmor CM Flashing and Sealant, LiquidArmor QS Flashing and Sealant, or LiquidArmor LT Flashing and Sealant, or approved substitution.
    c. Flashing and Sealant: Provide for sealing joints, seams and veneer tie penetrations through board insulation.
        1) Spray applied elastomeric liquid flashing and sealant, grey-blue color.
            (a) Basis-of-Design Product: Subject to compliance with requirements, provide DuPont LiquidArmor CM Flashing and Sealant (acrylic based formulation, spray or brush application) , or approved substitution.
    d. Trowel applied single component silicone flashing and sealant, gray color.
        1) Basis-of-Design Product: Subject to compliance with requirements, provide DuPont LiquidArmor LT Flashing and Sealant (silicone based formulation, trowel or caulk application) , or approved substitution.
    e. Self-Adhering Transition Flashing: Provide for through-wall flashing, roof-to-wall transitions, parapet transitions, above window kick-outs, wall to below-grade transitions, wall offsets, rough window openings, balcony transitions.

PART 3 EXECUTION

3.01 3.1 EXAMINATION

A. Examine substrates and installation conditions for compliance with requirements for installation conditions affecting performance of the work.
    1. Verify that metal wall studs, opening framing, bridging, bracing and other framing support members and anchorage have been installed within thermal wall system alignment tolerances and requirements.
    2. Verify that substrate surfaces to receive spray polyurethane foam are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
    3. Verify that items required to penetrate the thermal wall system are placed and penetration gaps and cracks are properly sealed before installation of spray polyurethane foam.
    4. Do not proceed with thermal and air barrier wall system installation until unsatisfactory conditions have been corrected.
    5. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.02 3.2 INSULATION INSTALLATION

A. Install insulation in accordance with manufacturer's recommendations. Fasten to exterior face of exterior metal stud wall framing using sheathing manufacturer’s recommended type and length screw

fasteners with washers. Abut panels tightly together and around openings and penetrations.

1. Install sheathing panels horizontally with blue aluminum facing to exterior. Use maximum lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing, plates or sill members.
2. Fasten panels to each support with fasteners spaced 12 inches on center at perimeter and 16 inches on center in panel field. Set back perimeter fasteners 3/8" from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of insulation. Do not countersink. Perimeter fasteners can be detailed to bridge the gap of abutting board joints due to the 1.75” diameter of the washer used to fasten the board to the studs. Maximum of two board joints may be bridged per fastener.
3. Install flashing at end and edge joints with sufficient hand pressure to ensure seal and in accordance with sheathing manufacturer's joint sealing recommendations.
4. Install flashing behind wall tie and mechanical fastening assemblies for rain screen claddings.
5. Seal sheathing joints and penetrations of sheathing in accordance with sheathing manufacturer's joint and penetration sealing recommendations.

END OF SECTION 072300

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SECTION 07 25 11
WEATHER BARRIERS - FIRE RETARDANT FLUID APPLIED

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire Resistive, fluid-applied membrane to serve as vapor retarder, air barrier, and water-resistive barrier.
   1. Vapor Retarders: Materials to make exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls water vapor-resistant and air tight.
   2. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.
   3. Water Resistive Barrier: Water does not leak through membrane or seams according to modified AATCC 127, 22 inch column of water for 5 hours.

B. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 03 3000 - Cast-in-Place Concrete: Vapor retarder under concrete slabs on grade.

B. Section 05 40 00 - Cold-Formed Metal Framing:

C. Section 07 2100 - Thermal Insulation: Vapor retarder installed in conjunction with batt insulation.

D. Section 07 25 00 - Weather Barrier: Air Barrier Sheet, Mechanically Fastened.

E. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.

F. Section 07 92 00 - Joint Sealers: Sealant materials and installation techniques.

G. Section 09 21 16 - Gypsum Board Assemblies: Exterior Sheathing.

1.03 DEFINITIONS

A. Weather Barrier: Assemblies that form either water-resistive barriers, air barriers, or vapor retarders.

B. Vapor Retarder: Air tight barrier made of material that is relatively water vapor impermeable, to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.
   1. Water Vapor Permeance: For purposes of conversion, 57.2 ng/(Pa s sq m) = 1 perm.

1.04 REFERENCE STANDARDS

A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.

B. AATCC Test Method 30 - Antifungal Activity, Assessment on Textile Materials: Mildew and Rot Resistance of Textile Materials; 2013.

C. ASTM D5590 - Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay; 2000 (Reapproved 2010).

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.

E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.

F. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.
   1. Exterior wall assemblies incorporating the product and accessories shall be tested in accordance with and comply with the acceptance criteria of NFPA 285 wall assemblies on the Project.
   2. The following products shall be verified as part of the NFPA 285 wall assemblies on the project.
      a. Air Barrier
      b. Insulation
      c. Cladding

G. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

H. ICC-ES AC38 - Acceptance Criteria for Water-Resistive Barriers; ICC Evaluation Service, Inc.; 2013.

I. ICC-ES AC148 - Acceptance Criteria for Flexible Flashing Materials; ICC Evaluation Service, Inc.; 2011.

J. ICC-ES AC212 - Acceptance Criteria for Water-Resistive Coatings Used as Water-Resistive Barriers over Exterior Sheathing; ICC Evaluation Service, Inc.; 2012.

1.05 SUBMITTALS

A. See Section 01 30 01 - Submittals for submittal procedures.

B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
   1. List of wall assemblies tested to NFPA 285.
   2. Window head and floor line details incorporated in the NFPA 285 testing.
   3. ICC-ES Reports which confirm compliance with ICC-ES AC212 and ICC-ES AC148, Acceptance Material for Flashing Materials.
   4. Documentation that products are recognized as acceptable air barrier materials by the Air Barrier Association of America (ABBA).
   5. Compatibility:
      a. Submit letter from manufacturer stating that materials proposed for use are permanently chemically compatible and adhesively compatible with adjacent materials proposed for use.
         1) Silicone sealants specified in Section 07 92 00 - Joint Sealers:
            (a) Applications: Use for:
               (1) Exterior: Tie-in to fluid-applied air barriers and their accessory flashing materials, especially at perimeter of openings in exterior walls such as framed curtain wall, storefronts, windows, door frames, and louver frames.
               (2) Sealants were selected for compatibility with Basis of Design weather barrier product. If you are submitting a different product, it is critical that you provide documentation of compatibility with sealants.
      b. Submit letter from manufacturer stating that cleaning materials used during installation are chemically compatible with each of the adjacent materials proposed for use.

C. Shop Drawings: Provide drawings of special joint conditions.

D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

E. Warranty: Provide the manufacturer’s minimum five year material warranty.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver weather barrier materials and components in manufacturer’s original, unopened, undamaged containers with identification labels intact.

B. Store weather barrier materials as recommended by weather barrier manufacturer

1.07 FIELD CONDITIONS

A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.01 VAPOR RETARDER MATERIALS (AIR BARRIER AND WATER-RESISTIVE)

A. Vapor Retarder Coating: Liquid applied, resilient, UV-resistant coating and associated joint treatment.
   1. Application: One-part spray or roller application.
   2. Composition:
      a. Fire resistant, flame-retardant, non-asphalt synthetic polymer.
      b. Water-based, air drying.
      c. Compatible with silicone and polyurethane sealants.

d. UV-resistant - 6th month exposure.

3. Nominal Dry Film Thickness: 40 mils (0.04 inch), minimum.
   a. High film thickness that can bridge cracks and seal around penetrations, creating a continuous, monolithic air, vapor and water barrier.
4. Self-sealing: Provide self-sealing properties when penetrated with commonly used fasteners.
   a. ASTM D 1970: No water leaking through nail penetration after 24 hours.
5. Water Vapor Permeance: 1.0 perm, maximum, when tested in accordance with ASTM E96, Method B.
6. Air Permeance:
   a. Material < 0.001 L/(s*m^2@75 Pa per ASTM E 2178 (unmodified).
   b. Installed product and accessories shall exhibit an air leakage rate, infiltration and exfiltration modes, measured after pressure cycling, not to exceed 0.2 L/s*m2 at 75 Pa (0.040 CFM/ft2 at 1.57 PSF) according to ASTM E 2357.
7. Water Resistive Barrier: Water does not leak through membrane or seams according to modified AATCC 127, 22 inch column of water for 5 hours.
8. VOC Content: Less than 140 g per L when tested in accordance with 40 CFR 59 Subpart D (EPA Method 24).
9. Resistance to Fungal Growth: No growth when tested according to ASTM D5590.
10. Code Acceptance: Comply with applicable requirements of ICC-ES Acceptance Criteria AC 212.
11. Fire Resistance Performance Requirements:
    a. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials:
       1) Class A, at full applied thickness (without the use of halogen or phosphorus flame retardants.)
          (a) Flame Spread: 25 or less.
          (b) Smoke developed: 450 or less.
12. Suitable for use on concrete, masonry, plywood and gypsum sheathing.
13. Joint Preparation Treatment: Coating manufacturer's recommended method, either tape or reinforcing mesh saturated with coating material.
14. Products:
    a. Carlisle Coatings and Waterproofing, Inc.; Product: Fire Resist Barritech NP-LT; www.carlisle-ccw.com.
    b. W.R. Meadows, Inc.; Air-Shield LSR: www.wrmeadows.com.
    c. NO SUBSTITUTIONS: All of the product options specified for use as wall system components have been carefully selected for compatibility with each other for compliance with NFPA-285, as documented by Third Party Selection Charts. For this reason, substitution requests are not permitted here.

2.02 PERMEABLE AIR BARRIER PRODUCT

A. Applications: This product is only to be utilized at transitions between new walls and existing walls where the primary insulation is batt type within the stud space.

B. Basis of Design:
   1. Manufacturer: Carlisle Coatings and Waterproofing, Inc.
   2. Product: Fire Resist Barritech NP.
      a. Minimum Thickness: 40-dry mil.
      b. Exterior U.V. exposure: 180 days.
      c. 180 days of outdoor exposure.
      d. Minimum installation temperature: 25 degrees.
      e. Minimum Permeance: 5 perms per ASTM E-96, Water Method (B).
      f. Flame Spread Index: 25 max. per ASTM E 84.
      g. Smoke Generated: 450 max. per ASTM E 84.
      h. Accessories: As recommended by primary manufacturer.

2.03 ACCESSORIES

A. Additional materials and installation are required at joints, transitions, openings, terminations, penetrations and similar surface irregularities. Perform detailing before or after product installation.

B. Provide the following from same manufacturer as air barrier membrane:
   1. Detail Flashing: Foil-faced butyl or foil-faced rubberized asphalt flashing, minimum 0.030” (30 mils) thickness. Approved with air barrier membrane in NFPA 285 wall assemblies.
      a. AlumaGRIP-701 by Carlisle Coatings & Waterproofing, Incorporated
   2. Reinforcing Fabric: Woven, synthetic polymer fabric
      a. DCH Reinforcing Fabric by Carlisle Coatings & Waterproofing, Incorporated
   3. Glass Mat: Randomly-oriented glass strands held in binder soluble in wet air barrier membrane. Offered in rolls of various widths
      a. LiquiFiber-W
   4. Fill Compound: 2-part, non-sag polyurethane sealant
      a. Carlisle Coatings & Waterproofing, Incorporated: CCW-703 V or CCW-201.
   5. Sealant Backers: As specified in Section 07 92 00.
   6. Primers, Cleaners, and Other Sealant Materials: As recommended by sealant manufacturer, appropriate to application, and compatible with adjacent materials.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions affecting installation of the air & vapor barrier and accessory products for compliance with requirements. Verify that surfaces and conditions are suitable prior to commencing Work of this section. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Verify that wall assemblies are dried in, such that water intrusion will not occur from above, behind or around the air barrier installation.

B. Surfaces shall be sound, dry and free of oil, grease, dirt, excess mortar or other contaminants.

C. Surfaces shall be supported and flush at joints without large voids or sharp protrusions.

D. Sheathing boards shall be flush at joints, with gaps between boards according to building code and sheathing manufacturer’s requirements. Sheathing boards shall also be securely fastened to the structure with proper fastener type, technique and spacing according to building code and sheathing manufacturer’s requirements. Sheathing boards shall be repaired or replaced if inspection reveals moisture damage, mechanical damage or if sheathing boards have exceeded the exposure duration or exposure conditions as required by the sheathing manufacturer.

E. Inform Architect in writing of
   1. Gaps or obstructions such as steel beams, angles, plates and projections which cannot be spanned or covered by Product or Accessories.
   2. Anticipated problems applying product and accessories over substrate.

F. Apply a ¾ inch cant of fill compound at the intersection of the base of the wall and the footing.

G. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

H. Fill cracks, gaps and joints exceeding ¼ inch width with fill compound or paintable sealant.

I. Fill rough gaps around pipe, conduit and similar penetrations with fill compound or polyurethane foam sealant shaved flush.

J. Clean and prime substrate surfaces to receive sealants in accordance with manufacturer's instructions.

3.03 DETAILING

A. Install product and accessories in details as directed in manufacturer's literature.

B. Sheathing joints, use any of the following methods:
   1. 4 inch detail flashing centered over joint.
   2. 4 inch reinforcing fabric imbedded in product and centered over joint.
   3. Paintable sealant or fill compound, tooled as shown in details.

C. Sheathing inside and outside corners. Flashing or reinforcement shall bear 3 inches minimum onto either side of angle change. Use any of the following methods:
   1. Minimum 9 inch detail flashing centered over angle change
   2. 12 inch reinforcing fabric centered over angle change and imbedded in product
   3. 12 inch glass mat centered over angle change and imbedded in product

D. Window openings. Flashing or reinforcement shall bear onto wall 3 inches minimum and shall return into window opening according to Project drawings. Use any of the following methods:
   1. Detail flashing
   2. Glass mat imbedded in product

E. Pipe or duct penetrations. Flashing or reinforcement shall bear onto wall 3 inches minimum and shall bear onto pipe or duct 3 inches, or according to Project drawings. Select any:
   1. Detail flashing
   2. Glass mat imbedded in product

F. Expansion or deflection joints. Flashing shall bear 3 inches minimum onto either side of joint. Select any:
   1. Detail flashing bellows or expansion bulb
   2. Transition membrane expansion bulb

G. Interface of dissimilar substrates: Flashing or reinforcement shall bear 3 inches minimum onto either side of joint. Select any:
   1. Minimum 9 inch detail flashing
   2. 12 inch reinforcing fabric imbedded in product
   3. 12 inch glass mat imbedded in product

3.04 INSTALLATION

A. Install materials in accordance with manufacturer's instructions.

B. Air Barrier & Vapor Retarder Product:
   1. Vapor Retarder: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
   2. Apply product over opaque wall surfaces as indicated in Project drawings.
   3. Spray or roller-apply product to achieve specified thickness in accordance with manufacturer's literature.
      a. Apply to a minimum dry thickness of 40 mil.
      b. Apply a continuous unbroken air barrier to substrates to minimum thickness recommended by manufacturer.
   4. Correct deficiencies in or remove air barrier that does not comply with requirements; repair substrates and reapply air barrier components.

C. Coatings:
   1. Prepare substrate in manner recommended by coating manufacturer; treat joints in substrate and between dissimilar materials as recommended by manufacturer.
   2. Use flashing to seal to adjacent construction and to bridge joints.

3.05 SCHEDULE

A. Wall substrates and roof or temporary roof shall be in place, effectively enclosing interior space, before proceeding with air barrier installation.

B. Seal penetrations made through installed product according to manufacturer's instructions and drawings.

C. Seal fenestration to product with detail membrane, transition membrane, polyurethane sealant, silicone sealant or polyurethane foam sealant according to Project drawings

D. Through-wall flashing may be installed before or after product. Seal termination of metal through-wall flashing to product with 6 inch width counter-flashing strip consisting of any of these:
   1. Detail flashing
   2. Reinforcing fabric imbedded in product
   3. Glass mat imbedded in product

E. Cladding shall be installed after product.

F. Rigid or semi-rigid insulation installed over product shall be attached with insulation adhesive and mechanical fastening according to insulation manufacturer and air barrier manufacturer's instructions.

G. Sequence Work to enable air barrier continuity at wall-to-foundation, shelf angle, wall-to-roof, fenestration, different wall assemblies and other conditions providing challenges to air barrier continuity.

3.06 FIELD QUALITY CONTROL

A. Owner's Inspection and Testing:
   1. Cooperate with Owner's testing agency.
   2. Allow access to work areas and staging.
   3. Notify Owner's testing agency in writing of schedule for Work of this Section to allow sufficient time for testing and inspection.
   4. Do not cover Work of this Section until testing and inspection is accepted.
   5. Forward written audit reports to the Architect within 10 working days of the inspection and test being performed.
   6. If the inspections reveal any defects, promptly remove and replace defective work at no additional cost to the Owner.

B. ASTM D4541 - Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers
   1. Test Procedure: A 4" bond disk is applied to an air barrier. The membrane is then scored down to the substrate. The pull tester is attached to the bond disc and pulled until the bond disc has achieved an adhesion failure. The maximum force to achieve adhesion failure and failure mode is recorded.
   2. End Result: Upon the completion of a successful test, the weather barrier meets the performance criteria for adhesive strength or does not meet criteria and further remediation may be required to pass.
   3. The minimum average of three tests are required to be 16 psi. This equates to a minimum average value on the test pull apparatus of 200.

C. ASTM E1186 - Standard Practices for Air Leakage Site Detection in Building Envelopes and Air Barrier Systems
   1. Test Procedure: Air leakage detection fluid is applied over the brick tie and seam/lap in the air/vapor barrier. The chamber is equipped with a centrifugal blower and pressure sensing device to create the specified positive pressure differential inside the chamber. Any sites of air leakage are detected through the visual appearance of bubbles in the detection fluid.
   2. End Result: Upon the completion of a successful test, the product meets the performance criteria for air infiltration resistance or does not meet criteria and further remediation may be required to pass.

D. ASTM E1186 (4.2.6) – Pass/fail criteria shall be no bubbles observed in the leak detection liquid

E. ASTM E1186 (4.2.7) – No major air leaks. A major leak is defined as air and smoke are visible and easily detectable by hand within one inch of the leak location(s)

3.07 PROTECTION

A. Protect from damage during application and remainder of construction period.

B. Inspect before covering. Repair or replace damaged material according to manufacturer's literature.

C. Product and accessories are not designed for permanent exposure. Cover with insulation or exterior cladding as soon as schedule allows.

D. Outdoor exposure of installed product and accessories shall not exceed air manufacturer's published limit.

E. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

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SECTION 07 41 13
METAL ROOF PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Architectural roofing system of preformed steel panels.

1.02 RELATED REQUIREMENTS

A. Section 05 12 00 - Structural Steel Framing: Roof framing and purlins.

B. Section 06 10 00 - Rough Carpentry: Roof sheathing.

1.03 REFERENCE STANDARDS

A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures 2010, with 2013 Supplements and Errata.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

C. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing 2009.

D. ASTM D4869/D4869M - Standard Specification for Asphalt-Saturated Organic Felt Underlayment Used in Steep Slope Roofing 2015.

E. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference 2005 (Reapproved 2012).

F. ICC-ES AC188 - Acceptance Criteria for Roof Underlayments 2012.

G. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Include layouts of roof panels, details of edge and penetration conditions, spacing and type of connections, flashings, underlayments, and special conditions.
   1. Show work to be field-fabricated or field-assembled.

C. Verification Samples: For each roofing system specified, submit samples of minimum size 12 inches square, representing actual roofing metal, thickness, profile, color, and texture.
   1. Include typical panel joint in sample.

D. Installer's qualification statement.

E. Test Reports: Indicate compliance of metal roofing system to specified requirements.

F. Warranty: Submit specified manufacturer's warranty and ensure that forms have been completed in Owner's name and are registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in the manufacture of roofing systems similar to those required for this project, with not less than 5 years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide strippable plastic protection on prefinished roofing panels for removal after installation.

B. Store roofing panels on project site as recommended by manufacturer to minimize damage to panels prior to installation.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Finish Warranty: Provide manufacturer's special warranty covering failure of factory-applied exterior finish on metal roof panels and agreeing to repair or replace panels that show evidence of finish degradation, including significant fading, chalking, cracking, or peeling within specified warranty period of 20 year period from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Metal Roof Panels: Provide complete roofing assemblies, including roof panels, clips, fasteners, connectors, and miscellaneous accessories, tested for compliance with the following minimum standards:
   1. Structural Design Criteria: Provide panel assemblies designed to safely support design loads at support spacing indicated, with deflection not to exceed L/180 of span length(L) when tested in accordance with ASTM E1592.
      a. Dead Loads: Weight of roofing system.
      b. Live Loads: As required by ASCE 7.
   2. Overall: Complete weathertight system tested and approved in accordance with ASTM E1592.
   3. Wind Uplift: Class 90 wind uplift resistance of UL 580.
   4. Thermal Movement: Design system to accommodate without deformation anticipated thermal movement over ambient temperature range of 100 degrees F.

2.02 ARCHITECTURAL METAL ROOF AND WALLS PANELS

A. Architectural Metal Roof Panels: Provide complete engineered system complying with specified requirements and capable of remaining weathertight while withstanding anticipated movement of substrate and thermally induced movement of roofing system.
   1. Basis of Design: Subject to compliance with requirements, provide Morin SLR-12-0 or comparable by on the following:
      a. Alcoa Inc.
      b. ATAS International, Inc.
      c. Berridge Manufacturing Company.
      d. CENTRIA Architectural Systems.
      e. Firestone Metal Products, LLC.
      f. fMBCI; a division of NCI Building Systems, L.P.
      g. Metal-Fab Manufacturing, LLC

B. Architectural Metal Panels: Factory-formed panels with factory-applied finish.
   1. Steel Panels:
      a. Zinc-coated steel complying with ASTM A653/A653M; minimum G60 galvanizing.
      b. Steel Thickness: Minimum 22 guage, 0.034 inch.
   2. Profile: Standing seam, with minimum 2.0 inch seam height; concealed fastener system for field seaming with special tool.
   3. Texture: Smooth.
   4. Exterior Finish: two-coat fluoropolymer.
   5. Colors: as indicated on Drawings.
   6. Width: Maximum panel coverage of 12 inches.
   7. Mill-Finish Steel Panels: Treat with passivating chemical prior to shipment, to inhibit formation of corrosion.

2.03 ATTACHMENT SYSTEM

A. Concealed System: Provide manufacturer's standard stainless steel or nylon-coated aluminum concealed anchor clips designed for specific roofing system and engineered to meet performance requirements, including anticipated thermal movement.

2.04 FINISHES

A. Fluoropolymer Coil Coating System: Manufacturer's standard multi-coat aluminum coil coating system complying with AAMA 2605, including at least 70 percent polyvinylidene fluoride (PVDF) resin, and at least 80 percent of coil coated aluminum surfaces having minimum total dry film thickness (DFT) of 0.9 mil, 0.0009 inch; color and gloss to match sample.

2.05 ACCESSORIES

A. Miscellaneous Sheet Metal Items: Provide flashings, trim, moldings, closure strips, preformed crickets, caps, and equipment curbs of the same material, thickness, and finish as used for the roofing panels. Items completely concealed after installation may optionally be made of stainless steel.

B. Rib and Ridge Closures: Provide prefabricated, close-fitting components of steel with corrosion resistant finish or combination steel and closed-cell foam.

C. Sealants:
   1. Exposed Sealant: Elastomeric; silicone, polyurethane, or silyl-terminated polyether/polyurethane.
   2. Concealed Sealant: Non-curing butyl sealant or tape sealant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation of preformed metal roof panels until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Broom clean wood sheathing prior to installation of roofing system.

B. Coordinate roofing work with provisions for roof drainage, flashing, trim, penetrations, and other adjoining work to assure that the completed roof will be free of leaks.

C. Remove protective film from surface of roof panels immediately prior to installation. Strip film carefully, to avoid damage to prefinished surfaces.

D. Separate dissimilar metals by applying a bituminous coating, self-adhering rubberized asphalt sheet, or other permanent method approved by roof panel manufacturer.

E. Where metal will be in contact with wood or other absorbent material subject to wetting, seal joints with sealing compound and apply one coat of heavy-bodied bituminous paint.

3.03 INSTALLATION

A. Overall: Install roofing system in accordance with approved shop drawings and panel manufacturer's instructions and recommendations, as applicable to specific project conditions. Anchor all components of roofing system securely in place while allowing for thermal and structural movement.
   1. Install roofing system with concealed clips and fasteners, except as otherwise recommended by manufacturer for specific circumstances.
   2. Minimize field cutting of panels. Where field cutting is absolutely required, use methods that will not distort panel profiles. Use of torches for field cutting is absolutely prohibited.

B. Accessories: Install all components required for a complete roofing assembly, including flashings, gutters, downspouts, trim, moldings, closure strips, preformed crickets, caps, equipment curbs, rib closures, ridge closures, and similar roof accessory items.

C. Install roofing felt / waterproof membrane and building paper slip sheet on roof deck before installing preformed metal roof panels. Secure by methods acceptable to roof panel manufacturer, minimizing use of metal fasteners. Apply from eaves to ridge in shingle fashion, overlapping horizontal joints a minimum of 2 inches and side and end laps a minimum of 3 inches. Offset seams in building paper and seams in roofing felt.

D. Roof Panels: Install panels in strict accordance with manufacturer's instructions, minimizing transverse joints except at junction with penetrations.

1. Form weathertight standing seams incorporating concealed clips, using an automatic mechanical seaming device approved by the panel manufacturer.

3.04 CLEANING

A. Clean exposed sheet metal work at completion of installation. Remove grease and oil films, excess joint sealer, handling marks, and debris from installation, leaving the work clean and unmarked, free from dents, creases, waves, scratch marks, or other damage to the finish.

3.05 PROTECTION

A. Do not permit storage of materials or roof traffic on installed roof panels. Provide temporary walkways or planks as necessary to avoid damage to completed work. Protect roofing until completion of project.

B. Touch-up, repair, or replace damaged roof panels or accessories before Date of Substantial Completion.

END OF SECTION

SECTION 07 42 13
METAL WALL PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured metal panels for exterior wall panels and subgirt framing assembly, with insulation, related flashings, and accessory components.

1.02 RELATED REQUIREMENTS

A. Section 05 40 00 - Cold-Formed Metal Framing: Wall panel substrate.

B. Section 07 21 00 - Thermal Insulation.

C. Section 07 25 00 - Weather Barriers: Weather barrier under wall panels.

D. Section 09 21 16 - Gypsum Board Assemblies: Wall panel substrate.

1.03 REFERENCE STANDARDS

A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

C. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric] 2014.

D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data - Wall System: Manufacturer's data sheets on each product to be used, including:
   1. Physical characteristics of components shown on shop drawings.
   2. Storage and handling requirements and recommendations.
   3. Installation instructions and recommendations.

C. Shop Drawings: Indicate dimensions, layout, joints, construction details, and methods of anchorage.

D. Samples: Submit two samples of wall panel and soffit panel, 12 inches by 12 inches in size illustrating finish color, sheen, and texture.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the work of this section with minimum five years of experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 MANUFACTURED METAL PANELS

A. Wall Panel System: Factory fabricated prefinished metal panel system, site assembled.
   1. Provide exterior wall panels and subgirt framing assembly.
   2. Design and size components to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of wall.
   3. Maximum Allowable Deflection of Panel: L/180 for length(L) of span.
   4. Movement: Accommodate movement within system without damage to components or deterioration of seals, movement between system and perimeter components when subject to seasonal temperature cycling; dynamic loading and release of loads; and deflection of structural support framing.

5. Drainage: Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
6. Fabrication: Formed true to shape, accurate in size, square, and free from distortion or defects; pieces of longest practical lengths.
7. Corners: Factory-fabricated in one continuous piece with minimum 2 inch returns.

B. Concealed-Fastener Exterior Wall Panels:
1. Basis of Design: Subject to compliance with requirements, provide Morin MX-1 wall panel, or comparable product by one of the following:
   a. Alcoa Inc.
   b. Architectural Building Components.
   c. Architectural Metal Systems; a Nucor company.
   d. ATAS International, Inc.
   e. Berridge Manufacturing Company.
   f. CENTRIA Architectural Systems.
   g. Firestone Metal Products, LLC.
   h. i. Metal-Fab Manufacturing, LLC
2. Profile: Vertical and horizontal, as indicated; style as indicated.
3. Side Seams: Double-interlocked, tight-fitting, sealed with continuous gaskets.
4. Material: Precoated steel sheet, 20 gauge, 0.0359 inch minimum thickness.
5. Panel Width: 12 inches.
6. Color: As selected by Architect from manufacturer's standard line.

C. Subgirt Framing Assembly:
1. 16 gauge, 0.0598 inch thick formed non-precoated steel sheet.
2. Profile as indicated; to attach panel system to building.

D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.

E. Expansion Joints: Same material, thickness and finish as exterior sheets; ___ gauge, ___ inch thick; manufacturer's standard brake formed type, of profile to suit system.

F. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

G. Anchors: Stainless steel.

2.02 MATERIALS

A. Precoated Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Structural Steel (SS) or Forming Steel (FS), with G90/Z275 coating; continuous coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

B. Precoated Aluminum Sheet: ASTM B209 (ASTM B209M), 3105 alloy, O temper, smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.03 ACCESSORIES

A. Gaskets: Manufacturer's standard type suitable for use with system, permanently resilient; ultraviolet and ozone resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that building framing members are ready to receive panels.

B. Verify that weather barrier has been installed over substrate completely and correctly.

3.02 PREPARATION

A. Install subgirts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.03 INSTALLATION

A. Install panels on walls and soffits in accordance with manufacturer's instructions.
B. Fasten panels to structural supports; aligned, level, and plumb.
C. Use concealed fasteners unless otherwise approved by Architect.
D. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.04 CLEANING

A. Remove site cuttings from finish surfaces.
B. Remove protective material from wall panel surfaces.

END OF SECTION

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SECTION 07 46 16
ALUMINUM SIDING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum siding.

B. Aluminum soffits.

C. Aluminum siding accessories.

1.02 REFERENCES

A. AAMA 1402 Standard Specifications for Aluminum Siding, Soffit and Fascia

B. CAN/ULC-S135 - Standard Test Method for the Determination of Combustibility Parameters of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter).

C. CGSB 93.2-M91 - Prefinished aluminum siding soffits and fascia, for residential use

D. CAN/ULC-S135 Standard Method of Test for Determination of Degrees of Combustibility of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter

E. Aluminum: Fabricate siding and trim from sheet aluminum complying ASTM B209, Aluminum Alloy 3105 - H14.

1.03 SUBMITTALS

A. Submit under provisions of Section 01 30 00 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Material descriptions, dimensions, and profiles.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

C. Shop Drawings: Indicate layout, methods of attachment, provisions for movement, flashing, trim, edge and field conditions, interface with adjacent materials, locations of cutouts or special shapes, existing construction, and details.

D. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

F. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

G. Closeout Submittals: Provide manufacturer's maintenance instructions that include recommendations for periodic checking and maintenance.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain rigorous production quality control standards to ensure that siding will perform as expected for its intended use. Products meet or exceed the requirements of AAMA 1402 Standard Specifications for Aluminum Siding, Soffit and Fascia.

B. Installer Qualifications: Installer with not less than three years documented experience with products specified.

C. Mock-Up: Provide a mock-up for evaluation of surface installation techniques and workmanship.
   1. Finish areas designated by Architect.
   2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
   3. Reinstall mock-up area as required to produce acceptable work.

D. Regulatory Compliance:
   1. International Building Code (IBC) - ESR-1083

2. CAN/ULC-S135 Standard Method of Test for Determination of Degrees of Combustibility of Building Materials Using an Oxygen Consumption Calorimeter (Cone Calorimeter)

1.05 DELIVERY, STORAGE, AND HANDLING

A. Package products in cartons marked with manufacturer's name, siding style, color, identifying lot number.

B. Store products in manufacturer's unopened packaging in clean, dry area, out of direct sunlight until ready for installation.

C. Store the cartons on a flat surface and support the entire length of the cartons. Do not store the cartons in stacks more than 6 cartons high.

D. Handle material to prevent damage.

1.06 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.07 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.08 WARRANTY

A. Provide manufacturer's 15 year warranty against defects in manufacturing that causes the products to rot, corrode, delaminate, or excessively swell from moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design:
   1. Longboard Architectural Products 120 - 1777 Clearbrook Rd. Abbotsford, BC, Canada V2T 5X5; info@longboardproducts.com

2.02 MATERIALS

A. Aluminum: Fabricate siding and trim from extruded aluminum 6063-T5.

2.03 ALUMINUM SIDING

A. Soffit and Wall: Roll-formed
   1. 6-inch V-Groove planks extruded aluminum 6063 T5.
   2. Profile: 6-inch (152mm) V-Groove X 24 ft (7315.2mm) plank.
   3. Thickness: 1/16 inch (1.57mm) base metal thickness.
   4. Finish coating: Woodgrains.
   5. Color: As selected by Architect from manufacturer's colors.

2.04 ACCESSORIES

A. Standard Siding Accessories: Provide outside corners, j-channels, trim coil, and fascia as indicated on the Drawing or as required for the project.
   1. Color: As selected by Architect from manufacturer's colors.
   2. Produced from the same materials and finish as the siding.

B. Plank Clips: 316 Stainless steel Quick-Screen Clips that are shipped loose for field installation.

C. Fasteners: Provide No. 8 screws to be used with clips.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. Confirm that all critical dimensions are as indicated on the Drawings.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Repair substrate flaws or defects before applying siding or soffits.

C. Where necessary, fur surfaces to an even plane and free from obstructions before application.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Install siding and soffits in accordance with the latest edition of the manufacturer's Installation Instructions.

B. Install aluminum siding, soffits, and accessories in accordance with best practice, with all joint members plumb and true.

C. Securely attach siding using methods and materials recommended by siding/soffit manufacturer for wind load conditions at project site.

3.04 FIELD QUALITY CONTROL

A. After installation of siding and soffits, check entire surface for obvious flaws or defects.

B. Replace and repair any problem areas, paying close attention to the substrate for causes of the problem.

3.05 CLEANING

A. After application of siding and soffits, clean as necessary to remove all fingerprints and soiled areas.

B. Upon completion of siding application, clean entire area, removing all scrap, packaging, and unused materials related to this work.

3.06 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 53 23
ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING - MULE-HIDE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. EPDM roofing membrane.

B. Overlay boards.

C. Insulation.

D. Flashings.

1.02 DEFINITIONS

A. EPDM - Ethylene-Propylene-Diene-Monomer.

1.03 REFERENCE STANDARDS

A. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2013.

B. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board 2014.

C. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2006a (Reapproved 2013).

D. ASTM D471 - Standard Test Method for Rubber Property--Effect of Liquids 2012.

E. ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers 2000 (Reapproved 2012).

F. ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and Elastomers by Impact 2014.

G. ASTM D4637/D4637M - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane 2013.

H. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2014.

I. FM (AG) - FM Approval Guide current edition.

J. FM DS 1-28 - Wind Design 2007.

K. FM DS 1-29 - Roof Deck Securement and Above-Deck Roof Components; Factory Mutual System 2006.

L. ITS (DIR) - Directory of Listed Products current edition.

M. NRCA (RM) - The NRCA Roofing Manual 2017.

N. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers; review preparation and installation procedures and coordination and scheduling necessary for related work.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Provide data indicating membrane materials, flashing materials, insulation, vapor retarder, surfacing, and fasteners.

C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, mechanical fastener layout, and paver layout.

D. Samples for Verification: Submit two samples ___ by ___ inches in size indicating insulation.

E. Executed warranty.

1.06 QUALITY ASSURANCE

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

B. Manufacturer Warranty: Provide 20-year manufacturer limited warranty for labor and materials of membrane and accessories determined to be defective resulting in roof leaks. Complete forms in Owner's name and register with manufacturer.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. 90mil fully adhered Firestone Full Force EPDM

B. Substitutions: Not permitted.

2.02 EPDM ROOFING SYSTEM

A. Roofing Assembly Requirements, Unballasted:
   1. Roof-Ceiling Fire Resistance Rating: Comply with FM (AG).
      a. Assembly Design No. _____.
   2. Roof Covering External Fire Resistance Classification: UL (DIR) or ITS (DIR) certified Class A.
   3. Factory Mutual Classification: Class 1 and windstorm resistance of 1-90, in accordance with FM DS 1-28.
   4. Insulation Thermal Resistance (R-Value): Overall R-30, minimum, following local authorities having jurisdiction (AHJ); provide insulation of overall thickness required.

2.03 EPDM ROOFING MEMBRANES

A. Non-reinforced membrane laminated to 100 percent solid pressure-sensitive adhesive and silicone-coated release liner on one side, comply with ASTM D4637/D4637M, Type I; formulated with fire retardants to inhibit the spread of flame.
   1. Product:
      a. Mule-Hide Products Co, Inc; SA (Self-Adhered) EPDM Membrane.
   2. Application: Self-adhering-technology (SAT) roofing system.
   3. Installation: Over insulation.
      a. Provide overlay boards on top of roof decking substrate and upper insulation layer.
   4. Color: Black.
   5. Thickness: 90 mil, 0.090 inch, nominal.
   6. Roll Size: 10 feet wide by 100 feet long.
   7. Solar Reflectance Index (SRI): Minimum of 9 based on 3-year aged value.
   8. Tensile Strength: 1,305 psi, measured in accordance with ASTM D412.
   9. Ultimate Elongation: At least 300 percent, measured in accordance with ASTM D412.
   10. Tear Strength: 150 lbf/inch, measured in accordance with ASTM D624.
   11. Water Vapor Permeance: Maximum of 0.10 perm, measured in accordance with ASTM E96/E96M using the Water Method.
   12. Resistance to Water Absorption: After 7 days of immersion at 158 degrees F, change in mass of 8 percent, maximum, measured in accordance with ASTM D471.
   13. Brittleness Temperature: Maximum of minus 49 degrees F, measured in accordance with ASTM D746.

2.04 OVERLAY BOARDS

A. High-Density Polyisocyanurate (ISO) Board: Rigid, closed-cell polyisocyanurate foam used as cover board for roofing systems; comply with ASTM C1289.
   1. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.

a. Class 4 - Faced with coated or uncoated glass fiber mat facers on both major surfaces of the core foam; maximum thickness of 1/2 inch.
b. Compressive Strength: Grade 1 - 109 psi, maximum.
c. Thermal Resistance, R-value: Class 4 - 2.5 at 1/2 inch thick at 75 degrees F.

2. Board Size: 48 by 96 inches.
3. Products:
   a. Mule-Hide Products Co, Inc; Poly ISO 1-HD.

B. Fiber-Reinforced Gypsum Board Sheathing: Comply with ASTM C1177/C1177M, fire resistant type:
1. Thickness: 1/2 inch, Type X, fire, water -resistant.
2. Products:
   a. Georgia-Pacific; DensDeck Roof Board.
   b. Georgia-Pacific; DensDeck Prime Roof Board.
   c. Georgia-Pacific; DensDeck StormX Prime Roof Board.
   d. USG Corporation; Securock Glass-Mat Roof Board.
   e. USG Corporation; Securock Ultralight Coated Glass-Mat Roof Board.

2.05 INSULATION

A. Provide insulation that is compatible with EPDM membranes, flashings, adhesives, and other accessories.

B. Insulation Plates: Round, 26 gauge galvalume-coated plates with reinforcing ribs providing wind uplift resistance, used with heavy-duty fasteners to attach insulation and cover boards.
1. Diameter: 3 inches.
2. Products:
   a. Mule-Hide Products Co, Inc; 3-Inch Insulation Plate.

C. Polyisocyanurate (ISO) Board Insulation: Rigid, closed-cell polyisocyanurate foam; comply with ASTM C1289.
1. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
   a. Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
   b. Compressive Strength: Classes 1-2-3, Grade 2 - 20 psi (138 kPa), minimum.
   c. Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3 - 8.4 (1.48) at 75 degrees F.
2. Board Size: 48 by 96 inches.
3. Board Thickness: At least 1.0 inch.
4. Board Edges: Square.
5. Products:

2.06 FLASHING

A. Flashing Membrane: Self-curing EPDM flashing membrane used with EPDM roofing systems as flashing for pipes, inside and outside corners, and various other penetrations that require a moldable product.
1. Color: Black.
2. Thickness: 90mil, 0.090 inch, nominal.
3. Roll Width: 12 inches.
4. Roll Length: 100 feet.
5. Products:
   a. Mule-Hide Products Co, Inc; Uncured EPDM Flashing Membrane.

2.07 ACCESSORIES

A. Membrane Cleaner: For field cleaning of EPDM membranes before seaming process; helps to loosen and remove dirt and other contaminants from membrane surface providing a suitable surface for application of primer, adhesives, and tapes.

1. Color: Clear.
2. Products:
    a. Mule-Hide Products Co, Inc; Weathered Membrane Cleaner.

B. Splice Adhesive: Butyl rubber-based adhesive is used for splicing EPDM roof membranes and uncured EPDM flashings.
1. Color: Black.
2. Splice Width Coverage: 3 inches wide, 150 linear feet/gal.
3. Products:
    a. Mule-Hide Products Co, Inc; Black Splice Adhesive.

C. Solvent-Based Bonding Adhesive: Synthetic rubber adhesive used to bond EPDM membranes to insulation boards, metal, concrete, wood, and other decking materials.
1. Color: Yellow.
2. Coverage Rate: 60 sq ft/gal on finished surface.
3. Products:
    a. Mule-Hide Products Co, Inc; Bonding Adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces and site conditions are ready to receive work.

B. Verify deck is supported and secure.

C. Verify deck is clean and smooth, flat, free of depressions, waves or projections, properly sloped, and suitable for installation of roof system.

D. Verify deck surfaces are dry and free of snow or ice.

E. Verify that roof openings, curbs, and penetrations through the roof are solidly set, and cant strips, nailing strips, and reglets are properly placed.

3.02 INSTALLATION - INSULATION

A. Attachment of Insulation:
1. Mechanically fasten first layer of insulation to deck following roofing manufacturer's installation instruction and FM (AG) Factory Mutual requirements.
2. Embed second layer of insulation into full bed of adhesive following roofing and insulation manufacturer's installation instructions.

B. Lay subsequent layers of insulation with joints staggered at least 6 inches from joints of preceding layer.

C. Lay boards with edges in moderate contact without forcing, and cut insulation to fit neatly to perimeter blocking and around penetrations through roof.

D. Do not apply more insulation than can be covered with membrane in same day.

3.03 INSTALLATION - MEMBRANE, GENERAL

A. Install EPDM membrane roofing system following manufacturer's installation instructions and NRCA (RM) applicable requirements.

B. Roll out membrane, free from wrinkles or tears, and install sheet in place without stretching.

C. Shingle membrane joints on sloped substrate in direction of drainage.

3.04 INSTALLATION - FULLY ADHERED MEMBRANE

A. Fully Adhered Application: Provide 90 mil, 0.090 inch thick EPDM membrane, 10 feet wide, and 100 feet long.

B. Unroll EPDM membrane and position without stretching; move large sheets into final position by encapsulating air under membrane and gently moving it into place.

C. Allow membrane to relax at least 30 minutes before installation.

D. Inspect and remove damaged membrane.

E. Lap sheets with inseam tape for proper field splice, as follows:

F. Align length of membrane perpendicular to direction of steel deck flutes.

G. Install full-width membrane sheets, to greatest extent possible, to minimize quantity of field seams.

H. Where partial width membrane sheets are used, install additional fasteners following manufacturer's installation instructions and project wind speed and wind uplift requirements.

I. Establish field, perimeter, and corner areas by the following method(s):
   1. Perimeter and corner areas are at least 8 feet in from roof edge.
   2. Factory Mutual insured buildings, comply with FM DS 1-29 requirements.

J. Membrane Bonding Adhesive: Install adhesive to substrate following manufacturer's installation instructions.
   1. If adhesive is sprayed, roll adhesive with a paint roller immediately after spraying.

K. Splicing of Lap Areas: Provide sealed lapped seams using in-seam tape.
   1. Overlap adjacent membrane at least 4 inches, and mark bottom sheet with crayon approximately 1/4-inch wide at edge of top sheet along entire length of splice as a guide to install in-seam tape.
   2. Fold back top sheet approximately 12 inches to allow for cleaning, removing excess mica by wiping seam area with clean damp rags, and dispose of rags as they become dirty.
   3. Prepare seam surfaces by scrubbing cleaned areas with tape primer using clean cotton rags or pads. Clean factory seams, as necessary, that intersect seam area to remove excess accumulations of mica. Replace rags and pads with clean ones as they become dirty. When dry, primed EPDM membrane should have uniform black color, and not have streaks; thoroughly stir tape primer before use.
      a. Do not stir low-VOC primer.
      b. Allow tape primer to dry until it no longer transfers to dry finger touch.
   4. Unroll at least 3 feet of in-seam tape, align tape with marked line, and press tape down onto bottom sheet using firm, even hand pressure, and continue for splice length; overlap tape roll ends at least 1 inch.
   5. Rest top sheet on poly backing after application, with at least 1/8 inch to maximum of 1/2 inch of tape extending beyond edge of splice. Provide a continuous piece of in-seam tape at each field and factory splice intersection.
   6. Peel poly backing off tape at 45-degree angle and parallel with roof allowing top sheet to be applied onto exposed tape. Press seam together using hand pressure and wiping toward edge of splice, then promptly roll seam with 2-inch wide steel roller, using positive pressure, toward seam edge.
   7. Lap Sealant: Wait at least two hours after rolling seam before applying, and only apply lap sealant at intersections with factory seams, where two pieces of tape overlap within seam, and on patches installed over T-joints. Apply a bead of lap sealant along overlap for at least 6 inches in each direction from center of overlap.
   8. Inspect seams thoroughly for fishmouths, bubbles, blisters, and wrinkles and repair as necessary.
      a. Where fishmouths or wrinkles occur through seam, cut out and patch using cured EPDM membrane; cured cover tape may also be used.
      b. Patch with cured membrane or tape that is at least 3 inches larger in each direction than area cut out, and provide round corners for each patch.
      c. Center patch over repaired area, and follow splicing procedures for appropriate material being used, as indicated.

L. Base Attachment of Additional Membrane Securements: Provide additional EPDM membrane mechanical attachment at perimeter of each roof level, base of walls, curbs, skylights, expansion joints, tie-ins, interior walls, bottom of valleys, angle changes that exceed inclines of 2 inches or greater per 12 inches, and various penetrations. Provide securement either horizontally to roof deck

or vertically to base of various penetrations.

1. Methods for Mechanical Attachment of Fully Adhered Membrane at Locations Indicated:

3.05 INSTALLATION - EPDM FLASHING

A. EPDM Membrane Flashing:
   1. Install membrane flashings concurrently with roof membrane as project progresses.
   2. Locations where water penetrates new roofing because of incomplete flashings, remove affected areas and replaced at Contractor's expense.
   3. Verify that flashing surfaces being fully adhered are compatible, dry, and smooth without excessive surface roughness.
   4. Provide flashing using cured EPDM membrane on walls, parapets, curbs, and penetrations, as applicable.
   5. Use of uncured EPDM flashing, or uncured EPDM flashing tape, is limited to areas such as corners, pipes, scuppers, patches over T-joints, patches at base of vertical field seams at angle changes, and other shaped penetrations that require molded flashing.
   6. Provide preformed flashing following manufacturer's installation instructions.
   7. Provide adhesives for membrane and vertical flashing following manufacturer's installation instructions.

B. Pipe Flashings:
   1. Flash single pipe penetrations with premolded pipe boots, where possible, and where pipe boots cannot be used, use uncured flashing or uncured flashing tape. Do not cut and patch premolded pipe boots to wrap around pipe.
   2. Provide pitch pans to seal pipe clusters where pipe boots or field fabrication is not possible, or for irregular objects with configuration that prevents standard flashing procedures.
   3. Install an insulated cold collar sleeve over hot pipes exceeding 180 degrees F as required for flashings to be adhered to; for cold collars install rain hoods to prevent leakage.

C. Roof Drains and Scuppers:
   1. Prepare surface around each drain to prevent distortion, tenting, or bridging of membrane, and provide smooth transition from roof surface to surface of drain bowl/clamping ring.
   2. Do not run field seams through drains or sumps, and if sheet layout causes a seam to fall in line with a drain, provide target patch at least 36 by 36 inches.
   3. Provide application of one full tube of water cut-off mastic for each drain applied to drain bowl, under membrane, where clamping ring will be seated, providing a continuous seal between membrane and drain bowl.
   4. For recovery projects, remove existing roofing materials, including lead flashings. Provide smooth tapered transition from new insulation to drain housing, and clean drain to be free of asphalt where clamping ring will be seated.

D. Expansion Joints: Install expansion joint in roof system wherever there is an expansion joint in roof deck or on walls.

E. Vertical Walls, Curbs, and Skylights Flashing:
   1. Provide cured EPDM membrane to flash vertical surfaces, except when flashing inside and outside corners, or other details that require molded flashing.
   2. Three basic methods of flashing vertical surfaces, and each method is dependent on mechanical base attachment used, as follows:
   3. Flashing height on vertical surfaces is at least 8 inches, where applicable.
   4. Use bonding adhesive to bond EPDM membrane flashing to vertical substrates, do not use it to bond EPDM to other EPDM surfaces.
   5. Use splice adhesive to bond EPDM to other EPDM surfaces.
   6. For recovery projects, where existing built-up roofing flashings are left in place, extend EPDM membrane flashing above height of existing flashings with membrane termination made directly to wall or curb surface.

a. Remove loose or unsecured existing flashings, and also remove excessive asphalt to provide a smooth surface.
b. Remove aluminum-coated flashings or cover with an appropriate rigid substrate; attach new substrate to provide rigid surface.
c. Corrugated metal siding, stucco, and various other irregular surfaces are not permitted substrates for adhering vertical flashings.
d. Do not cover existing through-wall counterflashings, weep holes, and overflow scuppers with EPDM membrane flashings, provide termination of membrane below through-wall counterflashings.

3.06 INSTALLATION - WALKWAYS

A. Provide walkways at locations as indicated on drawings.

B. Install pretaped EPDM walkway pads over clean, dry surfaces.

C. Ensure layout of areas where pads are being installed complies with manufacturer's installation instructions and the following:
1. Orient material so that it is placed between field seams with each adjacent and abutting section having at least a 6-inch gap; do not install walkway pads over seams or flashings.
2. Where pads are being applied, apply tape primer with a clean scotch-brite pad, and scrub membrane area in a circular motion to achieve a thin, even coating on membrane; this properly cleaned and primed area will be uniform in color without streaks, and free of globs or puddles.
3. Allow primer to properly flash off, wait until it does not transfer to a dry finger touch, then promptly install pads to minimize potential dust contamination and promote adhesion in colder weather.

3.07 CLEANING

A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

B. Remove bituminous or other inappropriate markings from finished surfaces.

C. In areas where finished surfaces are soiled by work of this section, consult manufacturer of surfaces for cleaning advice and comply with documented instructions.

D. Repair or replace defaced or damaged finishes caused by work of this section.

3.08 PROTECTION

A. Protect installed roofing and flashings from construction operations.

B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.

END OF SECTION

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SECTION 07 62 00
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fabricated sheet metal items, including copings, gravel stops, flashings and counterflashings.

B. Sealants for joints within sheet metal fabrications.

C. Reglets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood nailers for sheet metal work.

B. Section 07 61 00 - Sheet Metal Roofing.

C. Section 07 71 23 - Manufactured Gutters and Downspouts.

D. Section 07 92 00 - Joint Sealants: Sealing non-lap joints between sheet metal fabrications and adjacent construction.

E. Section 08 63 00 - Metal-Framed Skylights: Integral metal curbs.

1.03 REFERENCE STANDARDS

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2012.

B. AAMA 2604 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels 2013.

C. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels 2013.

D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric] 2014.

G. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free 2007 (Reapproved 2012).

H. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free 2007 (Reapproved 2012).

I. SPRI ES-1 - Wind Design Standard for Edge Systems Used with Low Slope Roofing Systems; Single Ply Roofing Industry; 2011. (ANSI/SPRI/FM 4435/ES-1)

J. NRCA (RM) - The NRCA Roofing Manual; 2017.

K. CDA A4050 - Copper in Architecture - Handbook current edition.

L. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.06 QUALITY ASSURANCE

A. Perform work in accordance with SMACNA (ASMM) and CDA A4050 requirements and standard details, except as otherwise indicated.

B. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.

B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

A. See Drawings for Locations:
   1. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, (0.0239 inch) thick base metal.
   2. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gauge, (0.0239) inch thick base metal, shop pre-coated with PVDF coating.
      a. PVDF (Polyvinylidene Fluoride) Coating: Superior Performance Organic Finish, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
      b. Color: As selected by Architect from manufacturer's standard colors.

2.02 FABRICATION

A. Form sections true to shape, accurate in size, square, and free from distortion or defects.

B. Form pieces in longest possible lengths.

C. Hem exposed edges on underside 1/4 inch; miter and seam corners.

D. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.

E. Fabricate corners from one piece with minimum 18 inch long legs; seam for rigidity, seal with sealant.

F. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 ROOF EDGE AND COPING FABRICATION

A. Roof Edge Flashings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Fascia and edge securement for roof membrane.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test methods RE-1 and RE-2 to positive and negative design wind pressure as defined by applicable local building code.
   3. Exposed Face Height: As indicated on drawings.

B. Copings: Factory fabricated to sizes required; mitered, welded corners; concealed fasteners.
   1. Configuration: Concealed continuous hold down cleat at both legs; internal splice piece at joints of same material, thickness and finish as cap; concealed stainless steel fasteners.
   2. Pull-Off Resistance: Tested in accordance with ANSI/SPRI/FM 4435/ES-1 using test method RE-3 to positive and negative design wind pressure as defined by applicable local building code.
   3. Wall Width: As indicated on drawings.
   4. Outside Face Height: As indicated on drawings.
   5. Inside Face Height: As indicated on drawings.

2.04 ACCESSORIES

A. Fasteners: Same material and finish as flashing metal, with soft neoprene washers.

B. Slip Sheet: Rosin sized building paper.

C. Primer: Zinc chromate type.

D. Protective Backing Paint: Asphaltic mastic, ASTM D4479 Type I.

E. Sealant to be Concealed in Completed Work: Non-curing butyl sealant.

F. Exposed Sealant: Type specified in Division 7 Section – Joint Sealers.

G. Plastic Cement: ASTM D4586/D4586M, Type I.

H. Reglets: Recessed type, rigid extruded PVC.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

A. Install starter and edge strips, and cleats before starting installation.

B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.

C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.03 INSTALLATION

A. Comply with drawing details.

B. Insert flashings into reglets to form tight fit; secure in place with lead wedges; seal flashings into reglets with sealant.

C. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..

D. Apply plastic cement compound between metal flashings and felt flashings.

E. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.

F. Seal metal joints watertight.

END OF SECTION

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SECTION 07 72 00
ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof hatches, manual and automatic operation, including smoke vents.

1.02 RELATED REQUIREMENTS

A. Section 05 31 00 - STEEL DECKING.

B. Section 05 00 00 - Metal Fabrications: for ladder and ships ladder providing access to roof hatches.

C. Section 06 10 00 - Rough Carpentry: for wood nailers.

D. Section 07 62 00 - Sheet Metal Flashing and Trim: Roof accessory items fabricated from sheet metal.

1.03 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used.
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.
   4. Maintenance requirements.

C. Certificate: For smoke hatches, provide certificate of approval from authority having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store products under cover and elevated above grade.

PART 2 PRODUCTS

2.01 ROOF HATCHES AND VENTS, MANUAL AND AUTOMATIC OPERATION

A. Roof Hatch Manufacturers:
   1. Bilco Company: www.bilco.com/#sle.
   2. Dur-Red Products: www.dur-red.com/#sle.
   3. Milcor, Inc: www.milcorinc.com/#sle.

B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
   1. Style: Provide flat metal covers, single leaf.
   2. Mounting Substrate: Provide frames and curbs suitable for mounting on corrugated metal roof deck with insulation.
   3. Performance characteristics:
      a. Cover shall be reinforced to support a minimum live load of 40 psf with a maximum deflection of 1/150th of the span or 20 psf wind uplift.
      b. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.
      c. Operation of the cover shall not be affected by temperature.
      d. Entire hatch shall be weather tight with fully welded corner joints on cover and curb.
   4. Size: As indicated on drawings; single-leaf style unless indicated as double-leaf.
      a. For Ladder Access: Single leaf; 30 x 37 inches.
      b. For Ships Ladder Access: Single leaf; 30 by 54 inches.
         1) For Ships Ladder Access (Code compliant, Building 4-Stories or over):
         2) Single leaf; 36-inches x 64-inches.

C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
   1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
   2. Height: 12 inches.
   3. The curb shall be formed with a 4-1/2” flange with 7/16” holes provided for securing to the roof deck.
   4. The curb shall be equipped with an integral metal cap flashing of the same gauge and material as the curb, fully welded at the corners, that features the Bil-Clip® flashing system, including stamped tabs, 6” (153mm) on center, to be bent inward to hold single ply roofing membrane securely in place.
   5. Curb insulation: Shall be 3” thick polyisocyanurate with an R-value = 20+.
   6. Curb Height: 12 inches from surface of roof deck, minimum.

D. Metal Covers: Flush, insulated, hollow metal construction.
   1. Capable of supporting 40 psf live load.
   2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
   3. Cover shall have a heavy extruded EPDM rubber gasket that is bonded to the cover interior to assure a continuous seal when compressed to the top surface of the curb.
   4. Cover insulation: Shall be 2” thick polyisocyanurate with an R-value = 12, fully covered and protected by an 18 gauge (1mm) aluminum liner.

E. Finishes: Factory finish shall be mill finish aluminum.

F. Ladder-Assist Post: Roof-hatch manufacturer's standard device for attachment to roof-access ladder.
   1. Basis of Design: Subject to compliance with requirements, provide Bilco Ladder Up Safety Post Type LU-1 (steel/powder coat), or comparable product.
   2. Operation: Post locks in place on full extension; release mechanism returns post to closed position.
   3. Height: 42 inches above finished roof deck.
   4. Material: Steel tube.
   5. Post: 1-5/8-inch- diameter pipe.
   6. Finish: Manufacturer's standard baked enamel or powder coat.

G. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.
   1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
   2. Hinges: Heavy duty pintle type.
   3. Hold open arm with vinyl-coated handle for manual release.
   4. Latch: Upon closing, engage latch automatically and reset manual release.
   5. Manual Release: Pull handle on interior.
   6. Locking: Padlock hasp on interior.
   7. Self Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
   8. Post and Rail Tops and Ends: weather resistent, closed orplugged with prefinished end fittings.
   9. Provide weep holes or other means to drain entrapped waterin hollow sections of framing members.
   10. Fabricate joints exposed to weather to be watertight.
   11. Fasteners: Manufacturer's standard, finished to match railing system

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.

3.04 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

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SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Firestopping systems.

B. Firestopping of joints and penetrations in fire resistance rated and smoke resistant assemblies, whether indicated on drawings or not, and other openings indicated.

C. Perimeter fire-resistive joint systems consisting of floor-to-wall joints between perimeter edge of fire-resistance-rated floor assemblies and exterior curtain walls.

1.02 RELATED REQUIREMENTS

A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

B. Section 01 70 00 - Execution and Closeout Requirements: Cutting and patching.

C. Section 07 81 00 - Applied Fire Protection.

1.03 REFERENCE STANDARDS

A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2015.

B. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops 2013a.

C. ITS (DIR) - Directory of Listed Products current edition.

D. FM 4991 - Approval Standard for Firestop Contractors 2013.

E. FM (AG) - FM Approval Guide current edition.

F. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168 current edition.

G. UL (FRD) - Fire Resistance Directory current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Schedule of Firestopping: List each type of penetration, fire rating of the penetrated assembly, and firestopping test or design number.

C. Product Data: Provide data on product characteristics, performance ratings, and limitations.

D. Sustainable Design Submittal: Submit VOC content documentation for all non-preformed materials.

1.05 QUALITY ASSURANCE

A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.
   1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
   2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and:
   1. Verification of minimum three years documented experience installing work of this type.
   2. Verification of at least five satisfactorily completed projects of comparable size and type.

D. Provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
   1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
   2. For floor penetrations with annular spaces exceeding 4 inches in width and exposed to possible loading and traffic, provide firestop systems capable of supporting floor loads involved, either by

installing floor plates or by other means.

3. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.

1.06 FIELD CONDITIONS

A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation; maintain minimum temperature before, during, and for three days after installation of materials.

B. Provide ventilation in areas where solvent-cured materials are being installed.

1.07 PROJECT STRATEGY FOR PERFORMING WORK

A. He who penetrates the assembly, firestops the penetration. (A separate fireproofing contractor sprays the structure while a multitude of trades install their own firestopping):
   1. Masonry
   2. Drywall
   3. Plumbing
   4. Fire Protection
   5. HVAC
   6. Electrical
      a. Power
      b. Communications
      c. Security

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Firestopping Manufacturers:
   1. 3M Fire Protection Products; _____: www.3m.com/firestop/#sle.
   2. Grace Construction Products.
   3. Johns Mansville.
   4. USG Corporation.
   5. Hilti, Inc; _____: www.us.hilti.com/#sle.
   6. Tremco Commercial Sealants & Waterproofing; TREMstop Acrylic: www.tremcosealants.com/#sle.

2.02 MATERIALS

A. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.

B. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING SYSTEMS

A. Firestopping: Any material meeting requirements.
   1. Fire Ratings: Use any system listed by UL or tested in accordance with ASTM E814 that has F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating (at all conditions where required by applicable codes) and that meets all other specified requirements.
   2. Provide systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
      a. L-Rated Systems: Provide through-penetration firestop systems with L-ratings of not more than 3.0 cfm/sq. ft at both ambient temperatures and 400 deg F.
   3. W-Rating Requirements:
      a. Description: Water-tight floor and wall through penetration firestop systems.
         1) To qualify as a Class 1 W-rated system, the firestop assembly must withstand a 3-ft head of water for 72 hours with no leakage.

b. Applications: Firestopping in floor systems, for areas that require water resistance to provide protection against water from floor to floor. Floor penetrations above the following rooms:
   1) Electrical rooms.
   2) Information Technology Rooms.
   3) Diagnostic Imaging Rooms.
   4) Other locations where specifically indicated on Drawings.
c. Basis of Design Products: Hilti, Inc.
   1) CFS-DID Drop-In Device
   2) CFS-S SIL GG Firestop Silicone Sealant
   3) CFS-S SIL SL Firestop Silicone Sealant
   4) CFS SP WB Firestop Joint Spray
   5) CFS SP SIL Firestop Silicone Joint Spray
   6) CP 606 Flexible Firestop Sealant
   7) CP 618 Firestop Putty Stick
   8) CP 620 Fire Foam
   9) CP 643N/644 Firestop Collar
   10) CP 648-E/S Firestop Wrap Strip
   11) CP 680-M/P/PX Cast-In Firestop Device
   12) CP 681 Tub Box Kit
   13) FS-ONE MAX High Performance Intumescent Firestop Sealant

2.04 FILL MATERIAL SCHEDULE

A. Manufacturers:
   1. Products: Subject to compliance with requirements, provide one of the through-penetration firestop systems indicated for each application that are produced by one of the following manufacturers:
      a. Specified Technologies, Inc.
      b. Hilti, Inc.
      c. 3M; Fire Protection Products Division.
      d. Tremco; Sealant/Weatherproofing Division.

B. The following schedule is based on products by one manufacturer providing the quality standard to be used as the basis for comparison. Equivalency of products of other manufacturers shall be determined by Architect reviewing substitution requests provided during bidding, by bidder, in the form of a table comparing all performance criteria with product prividing the quality standard.

C. Provide products red in color, to distinguish it from non-fire-stop materials.

D. Sealants, caulking materials, or foams for use with noncombustible and combustible pipes

   (closed and open systems), conduit, and/or sheet metal ducts penetrating floors, the following products are acceptable:
   1. Hilti CFS-S SIL GG Firestop Silicone Sealant, Self Leveling.
   2. Hilti CFS-S SIL GG Firestop Silicone Sealant, Gun Grade.
   3. Sealants, caulking materials, or foams for use with cable bundles penetrating floors, the following products are acceptable:
   4. Hilti CFS-S SIL GG Firestop Silicone Sealant.
   5. Hilti CP 653 Firestop Speed Sleeve with integrated smoke seal fabric membrane.

E. Sealants, caulking materials, or foams for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following products are acceptable:
   1. Hilti CFS-S SIL GG Firestop Silicone Sealant.
   2. Hilti FS-ONE MAX Intumescent Firestop Sealant.
   3. Hilti CP 620 Fire Foam.
   4. Hilti CP 606 Flexible Firestop Sealant.

F. Sealants or caulking materials for use with sheet metal ducts, the following products are acceptable:
   1. Hilti CFS-S SIL GG Firestop Silicone Sealant.

2. Hilti CP 606 Flexible Firestop Sealant.
3. Hilti FS-ONE MAX Intumescent Firestop Sealant.

G. Intumescent sealants, caulking materials for use with combustible items (penetrant consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe, the following products are acceptable:
1. Hilti CFS-S SIL GG Firestop Silicone Sealant.
2. Hilti FS-ONE MAX Intumescent Firestop Sealant.
3. Hilti CP 618 Firestop Putty Stick.
4. Hilti CP 620 Fire Foam.
5. Hilti CP 606 Flexible Firestop Sealant.
6. Hilti CP 653 Firestop Speed Sleeve with integrated smoke seal fabric membrane.
7. Hilti CFS-SL SK Firestop Sleeve Kit.
8. Hilti CFS-SL GP Firestop Gangplate used in conjunction with Hilti CP 653.

H. Sealants for use with fire-resistance-rated construction joints, the following products are acceptable:
1. Hilti CP 672 Speed Spray
2. Hilti CP 606 Flexible Firestop Sealant
3. Hilti CFS-S SIL GG Firestop Silicone Sealant.
4. Sealants for use as part of a Perimeter Fire Barrier System between fire-resistance-rated floors and exterior wall assemblies, the following products are acceptable:
5. Hilti CP 672 Speed Spray
6. Hilti CP 604 Self-leveling Firestop Sealant
7. Hilti CFS-S SIL SL Firestop Silicone Sealant.

I. Pre-formed mineral wool designed to fit flutes of metal profile deck and gap between top of wall and metal deck profile; use as a backer for spray material.
1. Hilti CP 777 Speed Plugs
2. Hilti CP 767 Speed Strips

J. Intumescent sealants, caulking materials for use at the base of walls at shaft enclosures, the following products are acceptable:
1. Hilti CFS-S SIL GG Firestop Silicone Sealant.

2.05 FIRE SAFING INSULATION

A. Fire Safing Insulation: Thermafiber, FireSpan 40 complying with the following:
1. ASTM C 665 Type I, III (Class A, Category 1).
2. ASTM C 612 FireSpan 40 Type IA, IB, II, III, IVA, IVB.
3. ASTM E 136 Rated Non-combustible per NFPA Standard 220.
4. ASTM E 96 Unfaced, 50 Perms as tested.
5. ASTM E 96 Foil Faced, 0.02 Perms as tested.
6. ASTM C 1104 Sorption less than 1% by volume.
7. ASTM C 356 Linear Shrinkage <2% @ 1200º F (650º C).
8. ICC ES Report ER-2331.
9. Recycled Content: EPA Choice Fiber (US Government Buildings): 75%.

B. Approved equivalent.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify openings are ready to receive the work of this section.

3.02 PREPARATION

A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.

B. Remove incompatible materials that could adversely affect bond.

C. Install backing materials to prevent liquid material from leakage.

D. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03 INSTALLATION

A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.

B. Do not cover installed firestopping until inspected by authorities having jurisdiction.

3.04 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed.
   1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Contractor's name, address, and phone number.
   3. Through-penetration firestop system designation of applicable testing and inspecting agency.
   4. Date of installation.
   5. Through-penetration firestop system manufacturer's name.
   6. Installer's name.

3.05 FIELD QUALITY CONTROL

A. Inspecting Agency: Owner may engage a qualified, independent inspecting agency to inspect Work of this Section, including those related to qualifications, conducting inspections, and preparing test reports:
   1. Through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements.
   2. Fire Stop Joint Systems. Independent inspecting agency shall comply with ASTM E 2393 requirements.

B. Inspecting of completed installations of fire-resistive joint systems shall take place in successive stages as installation of fire-resistive joint systems proceeds.
   1. Do not proceed with installation of joint systems for the next area until inspecting agency determines completed work shows compliance with requirements.
   2. Inspecting agency shall state in each report whether inspected fire-resistive joint systems comply with or deviate from requirements.
   3. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

C. Where deficiencies are found, repair or replace systems so they comply with requirements.

3.06 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.07 PROTECTION

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

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SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nonsag gunnable joint sealants.

B. Self-leveling pourable joint sealants.

C. Joint backings and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 84 00 - Firestopping: Firestopping sealants.

B. Section 08 80 00 - Glazing: Glazing compounds.

1.03 REFERENCE STANDARDS

A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2015.

B. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications 2012.

C. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2000 (Reapproved 2011).

D. ASTM C1193 - Standard Guide for Use of Joint Sealants 2013.

E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2008 (Reapproved 2012).

F. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints 2013.

G. SCAQMD 1168 - South Coast Air Quality Management District Rule No.1168 current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
   1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
   2. List of backing materials approved for use with the specific product.
   3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
   4. Substrates the product should not be used on.
   5. Substrates for which use of primer is required.
   6. Substrates for which laboratory adhesion and/or compatibility testing is required.
   7. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
   8. Sample product warranty.
   9. Include project specific joint sealant schedule including the following:
      a. Sealant Type # as defined per this specification Section.
      b. Manufacturer and product.
      c. Adjacent materials and associated sealant Colors.

C. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.

D. Samples for Verification: To Architect, submit at least two physical samples for verification of color of each required sealant.

E. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

F. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.

G. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.

1.05 QUALITY ASSURANCE

A. Maintain one copy of each referenced document covering installation requirements on site.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.

D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
   1. Adhesion Testing: In accordance with ASTM C794.
   2. Compatibility Testing: In accordance with ASTM C1087.
   3. Stain Testing: In accordance with ASTM C1248; required only for stone substrates.
   4. Allow sufficient time for testing to avoid delaying the work.
   5. Deliver to manufacturer sufficient samples for testing.
   6. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
   7. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

E. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
   1. Identification of testing agency.
   2. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.
      a. Test date.
      b. Copy of test method documents.
      c. Age of sealant upon date of testing.
      d. Test results, modeled after the sample form in the test method document.
      e. Indicate use of photographic record of test.

F. Field Adhesion Test Procedures:
   1. Allow sealants to fully cure as recommended by manufacturer before testing.
   2. Have a copy of the test method document available during tests.
   3. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
   4. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
   5. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to Owner.
   6. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.

G. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
   1. Sample: At least 18 inches long.
   2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the "1 inch mark" is that distance from the substrate, the test has failed.
   3. If either adhesive or cohesive failure occurs prior to minimum elongation, take necessary measures to correct conditions and re-test; record each modification to products or installation

procedures.

1.06 MOCK-UP

A. Provide mock-up of sealant joints in conjunction with window under provisions of Section 01 40 00.

B. Construct mock-up with specified sealant types and with other components noted.

C. Locate where directed.

D. Mock-up may remain as part of the Work.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective work within a five year period after Date of Substantial Completion.

C. Warranty: Include coverage for installed sealants and accessories that fail to achieve watertight seal , exhibit loss of adhesion or cohesion, or do not cure.
   1. Non-Stain Warranty:
      a. Twenty year period after Date of Substantial Completion.
      b. Manufacturer shall pre-approve and test as required per conditions of warranty.

PART 2 PRODUCTS

2.01 JOINT SEALANT APPLICATIONS

A. Scope:
   1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
      a. Joints between door, window, and other frames and adjacent construction.
      b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
         1) Exception: Through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
      c. Other joints indicated below.
   2. Do not seal the following types of joints.
      a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
      b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
      c. Joints where installation of sealant is specified in another section.
      d. Joints between suspended panel ceilings/grid and walls.

2.02 JOINT SEALANTS - GENERAL

A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

B. Color of Sealant, generally, shall be the color of the adjacent material that lies in the same plane as the sealant. Verify all colors with Architect prior to installation.

C. Carefully study the Drawings and furnish and install the proper sealant and caulking at each point where indicated on the Drawings plus at all other points where sealants and caulking are essential in maintaining the continued integrity of the weather-tight barrier.

D. Joint locations and conditions not covered in the schedule below shall be brought to the attention of the Architect. The contractor shall propose, in writing, sealant types for each joint location and condition in question, to the Architect for approval prior to sealant installation.

2.03 SEALANT SCHEDULE

A. Type 1 - Silicone Sealant: ASTM C920, Grade NS, Class 50, Uses NT, A, G, M, O; single component (Type S), neutral curing, non-sagging, medium-modulus, Mid Shore A hardness, stain tested (ASTM C1248).
   1. Color: To be selected by Architect from manufacturer's full range.

2. Movement Capability: Plus and minus 50 percent.
3. Applications: Use for:
    a. Interior:
        1) Concealed joints on the interior side of exterior wall surfaces.
            (a) Vertical control joints.
            (b) Concealed joints on the interior side of exterior precast concrete (Except when the Precast Manufacturer's product data specifically directs the use of Type 1 joint sealant.)
            (c) Interior perimeters of mechanical and electrical items which penetrate the exterior building facade.
        2) Interior exposed control joints in unpainted masonry walls.
        3) Interior perimeters of exterior openings where opening frames meet wall surfaces.
        4) Joints in tile walls.
        5) Joints in kitchen counter tops and work surfaces.
        6) Joints between food service equipment and surrounding construction.
        7) Other interior joints, where incidental food contact may occur.
4. Products:
    a. Dow Corning Corporation; 795: www.dowcorning.com.
    b. Momentive Performance Materials, Inc (GE Silicones products); Silpruf SCS2000.: www.momentive.com.
    c. Pecora Corporation; 895NST Medium Modulus Structural Glazing & Weatherproofing Silicone Sealant - Class 50: www.pecora.com.
    d. Tremco Global Sealants; Spectrem 2: www.tremcosealants.com.
    e. Substitutions: Not permitted.

B. Type 4 - Acoustical Sealant for Concealed Locations: Class 7.
1. Composition: Acrylic latex emulsion sealant.
2. Applications:
    a. Use for concealed interior locations only:
        1) Joints at tops of non-load bearing masonry walls at the underside of roof or floor decks.
        2) Tops of non fire-rated partitions.
        3) Sealant bead between top stud runner and structure and between bottom stud track and floor.
        4) Penetrations through non fire-rated partitions.
3. Products:
    a. Hilti; Smoke and Acoustic Sealant (CP 506)
    b. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant: www.pecora.com.
    c. USG; Sheetrock Brand Acoustical Sealant: www.usg.com
    d. Tremco Incorporated: Acoustical Sealant.
    e. Substitutions: Not permitted.

C. Type 7 - Pourable Polyurethane Sealant: ASTM C920, Grade P, Class 25, Uses T, I, M, A, G, O; multi component, chemical curing, non-staining, non-bleeding, capable of continuous water immersion, non-sagging type, pourable Grade-P.
1. Color: To be selected by Architect from manufacturer's full range.
2. Movement Capability: Plus and minus 25 percent.
3. Shore A Hardness Range: 30-35.
4. Applications: Use for:
    a. Interior:
        1) Expansion and control joints in horizontal wearing surfaces (Except for Sherwin Williams Ceramic Carpet floor systems).
            (a) Isolation and contraction joints in cast-in-place concrete slabs.
            (b) Expansion and control joints in brick floors.
            (c) Expansion and control joints in stone floors.
            (d) Expansion and control joints in tile floors.

5. Products:
    a. Pecora Corporation; DynaTrol II General Purpose Two Part Polyurethane Sealant: www.pecora.com.
    b. BASF Construction Chemicals-Building Systems; MasterSeal SL 2: www.buildingsystems.basf.com.
    c. Sika Corporation: SL2..
    d. Tremco Incorporated; THC 901 or Vulkem 445SL.
    e. Substitutions: Not permitted.

D. Type 9 - Acrylic Emulsion Latex: ASTM C834, single component, non-staining, non-bleeding, non-sagging, Type OP, Grade NF.
1. Color: White.
2. Movement Capability: +-12.5 percent.
3. Applications: Use for:
    a. Interior:
        1) Control joints in exposed joints of drywall partitions and ceilings.
        2) Perimeter joints of walls including wall-to-wall intersections and wall-to-floor intersections.
4. Products:
    a. Pecora Corporation; AC-20 + Silicone Acrylic Latex Caulking Compound: www.pecora.com.
    b. BASF Construction Chemicals-Building Systems; Sonolac: www.buildingsystems.basf.com.
    c. Tremco Global Sealants; Tremflex 834: www.tremcosealants.com.
    d. Substitutions: Not permitted.

E. Type 10 - Non-skinning, Non-hardening, Flexible, Synthetic Butyl Sealant.
1. Applications: Use for applications as indicated on Drawings.
2. Products:
    a. Pecora Corporation; BA-98.
    b. Tremco Incorporated; Trempro JS-733.
    c. Substitutions: Not permitted.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joints are ready to receive work.

B. Verify that backing materials are compatible with sealants.

C. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
3. Record each test on Preinstallation Adhesion Test Log as indicated.
4. If any sample fails, review products and installation procedures, consult manufacturer, or take whatever other measures are necessary to ensure adhesion; re-test in a different location; if unable to obtain satisfactory adhesion, report to Architect.
5. After completion of tests, remove remaining sample material and prepare joint for new sealant installation.

3.02 PREPARATION

A. Remove loose materials and foreign matter that could impair adhesion of sealant.

B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.

C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.

D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

E. Concrete Floor Joints That Will Be Exposed in Completed Work: Test joint filler in inconspicuous area to verify that it does not stain or discolor slab.

3.03 INSTALLATION

A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.

B. Perform installation in accordance with ASTM C1193.

C. Perform acoustical sealant application work in accordance with ASTM C919.

D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.

E. Install bond breaker backing tape where backer rod cannot be used.

F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.

G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.

H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 CLEANING

A. Clean adjacent soiled surfaces.

3.05 PROTECTION

A. Protect sealants until cured.

END OF SECTION

SECTION 07 95 13
EXPANSION JOINT COVER ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion joint cover assemblies for wall and ceiling surfaces.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices, available colors and finish, and _____.

C. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, affected adjacent construction, anchorage locations, and _____.

D. Samples: Submit two samples 6 inch long, illustrating profile, dimension, color, and finish selected.

E. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

2.02 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

A. Type of Movement: Wind sway.
   1. Nominal joint with: As indicated on Drawings.

B. Interior Non-Fire-Rated Wall/Ceiling Joints.
   1. Manufacturers:
      a. Construction Specialties, Inc FWF: www.c-sgroup.com/#sle.
      b. Balco, Inc: FCWW Flush Wall, www.balcousa.com/#sle.

C. Exterior Wall Joints Flush Wall
   1. Manufacturers:
      a. Balco, Inc: FCWW Flush Wall, www.balcousa.com/#sle.
      b. Construction Specialties, Inc: FWF, www.c-sgroup.com/#sle.

D. Exterior Wall Joints where face of wall(s) is uneven.
   1. Manufacturers:
      a. EMSEAL Joint Systems, Ltd; BG System: www.emseal.com/#sle..
      b. Balco, Inc; Exterior Wall, BCSW Pre-compressed: www.balcousa.com/#sle..

2.03 EXPANSION JOINT COVER ASSEMBLIES

A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
   1. Joint Dimensions and Configurations: As indicated on drawings.
   2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
   3. Joint Cover Styles: As indicated on drawings.
   4. Joint Movement Capability: If not indicated, provide minimum plus/minus 25 percent joint movement capability.
   5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
   6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.

2.04 MATERIALS

A. Resilient Seals:
   1. For Ceilings: Any resilient material, flush, pleated, or hollow gasket.

2. For Pedestrian Traffic Applications: EPDM rubber, Neoprene, or Santoprene; no PVC; Shore A hardness of 40 to 50 Durometer.
3. Color: As selcted from standard colors.

B. Closed cell, stabilized polymer foam with a colorized silicone coating.
1. ASTM D2240 Shore A 15 durometer silicone coating.
2. Density: 10 lb/ft³ (160kg/m³).
3. Thermal Conductivity: R-4 per ASTM C177.
4. Color: As selcted from standard colors.

C. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

2.05 FABRICATION

A. Joint Covers: aluminum frame construction, retainers with resilient elastomeric filler strip, designed to permit plus or minus 50 percent joint movement with full recovery, flush mounted.

B. Provide joint components in single length wherever practical. Minimize site splicing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.02 INSTALLATION

A. Install components and accessories in accordance with manufacturer's instructions.

B. Align work plumb and level, flush with adjacent surfaces.

C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Non-fire-rated hollow metal doors and frames.

B. Hollow metal frames for wood doors.

C. Hollow metal borrowed lites glazing frames.

D. Accessories, including glazing.

1.02 RELATED REQUIREMENTS

A. Section 08 71 00 - Door Hardware.

B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.

C. Section 09 91 23 - Interior Painting: Field painting.

D. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design 2010.

B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames 2007 (R2011).

C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors 2011.

D. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames 2003 (R2009).

E. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100) 2014.

F. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2011.

G. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.

H. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable 2015.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2014.

J. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames 2014.

K. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

L. ITS (DIR) - Directory of Listed Products current edition.

M. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames 2007.

N. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames 2006.

O. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2016.

P. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives 2016.

Q. NFPA 105 - Standard for the Installation of Smoke Door Assemblies and Other Opening Protectives; 2010.

R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2012.

S. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames 2013.

T. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

V. UL 1784 - Standard for Air Leakage Tests of Door Assemblies Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.

C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.

D. Door Schedule:
   1. Include label/fire rating.
   2. Frame anchorage.

E. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.

B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Hollow Metal Doors and Frames:
   1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com/#sle.
   2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
   3. Steelcraft, an Allegion brand: www.allegion.com/#sle.
   4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:
   1. Steel Sheet: Comply with one or more of the following requirements; galvannealed steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
   2. Accessibility: Comply with ICC A117.1 and ADA Standards.

B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

A. Door Finish: Factory primed and field finished.

B. Interior Doors, Non-Fire-Rated:
   1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

a. Level 2 - Heavy-duty.
b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 2 - Seamless.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.

2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
3. Door Thickness: 1-3/4 inches, nominal.
4. Door Face Sheets: Flush.
5. Door Finish: Factory primed and field finished.

C. Fire-Rated Doors:
1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
a. Level 2 - Heavy-duty.
b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
c. Model 2 - Seamless.
d. Door Face Metal Thickness: 18 gauge, 0.042 inch, minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
a. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
b. Provide units listed and labeled by UL (DIR) or ITS (DIR).
1) A door labeled for UL 10C positive pressure compliance must be installed in each of these door frames.
c. Attach fire rating label to each fire rated unit.
1) These frames also meet the requirements of UL 10B, NFPA 252, and ASTM E-152.
d. Smoke and Draft Control Doors (Fire rated door assemblies in corridor walls, smoke barriers, elevator lobbies, and stair doors, shall comply with requirement for smoke and draft control. See Life Safety Drawings for walls with these designations): Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
1) Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
2) Gasketing: Provide gasketing or edge sealing as necessary to achieve leakage limit.
(a) Provide gasketing/edge sealing National Guard #2525:
3) Label: Include the "S" label on fire-rating label of door.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
4. Door Thickness: 1-3/4 inches, nominal.
5. Door Face Sheets: Flush.
6. Temperature-Rise Limit: At vertical exit enclosures, exit passageways and at other locations where indicated, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of standard fire-test exposure.
7. Door Finish: Factory primed and field finished.

2.04 HOLLOW METAL FRAMES

A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.

B. Frame Finish: Factory primed and field finished.

C. General:
1. Comply with the requirements of grade specified for corresponding door.
a. ANSI/SDI A250.8 (SDI-100), Level 2 and 3 Door Frames: 14 gage, 0.067 inch, minimum thickness.

b. Frames for Wood Doors: Comply with frame requirements in accordance with ANSI/SDI A250.8 (SDI-100), Level 2, 16 gage, 0.053 inch, minimum thickness.

2. Finish: Factory primed and field finished.
3. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
4. Frames Wider than 48 Inches: Reinforce with steel channel fitted tightly into frame head, flush with top.
5. Full profile/continuously welded type.

D. Exterior Door Frames: Full profile/continuously welded type.
1. Basis of Design: Ceco Door, ASSA ABLOY, Mercury Thermal Break Steel Frames
2. Incorporates a bonded thermal break with Pemko S44 compression weather-stripping
3. Independently tested for thermal performance with Trio-E (0.36 U-Value) in accordance with NFRC 102-2014 and ASTM test methods.
4.
5. Install with manufacturers associated thermal anchors.
6. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
7. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
8. Frame Finish: Factory primed and field finished.

E. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
1. Terminated Stops: Provide at interior doors; closed end stop terminated 6 inch, maximum, above floor at 45 degree angle.
2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
3. Frame Finish: Factory primed and field finished.

F. Door Frames, Fire-Rated: Full profile/continuously welded type.
1. Fire Rating: Same as door, labeled.
2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
3. Frame Finish: Factory primed and field finished.

G. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.

H. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.

I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
1. Color: As selected by Architect from manufacturer's standard range.

2.06 ACCESSORIES

A. Glazing: As specified in Section 08 80 00, factory installed.

B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.

C. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.

D. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

2.07 FRAME ANCHORS

A. Jamb Anchors:
1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 INSTALLATION

A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.

B. Install fire rated units in accordance with NFPA 80.

C. Coordinate frame anchor placement with wall construction.
   1. A minimum of 1/2” penetration of gypsum wall board is required at all drywall frames.

D. Install door hardware as specified in Section 08 71 10.
   1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.

E. Comply with glazing installation requirements of Section 08 80 00.

F. Coordinate installation of electrical connections to electrical hardware items.

G. Touch up damaged factory finishes.

3.03 TOLERANCES

A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.

B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

A. Adjust for smooth and balanced door movement.

3.05 SCHEDULE

A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

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SECTION 08 14 16
FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush wood doors; flush and flush glazed configuration; non-rated.

1.02 RELATED REQUIREMENTS

A. Section 08 11 13 - Hollow Metal Doors and Frames.

B. Section 08 71 00 - Door Hardware.

C. Section 08 80 00 - Glazing.

D. Section 13 09 00 - Radiation Protection.

1.03 REFERENCE STANDARDS

A. ASTM E1408 - Standard Test Method for Laboratory Measurement of the Sound Transmission Loss of Door Panels and Door Systems; 1991 (Reapproved 2000).

B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014.

C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0 2016.

D. ICC (IBC) - International Building Code 2015.

E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

F. NFPA 80 - Standard for Fire Doors and Other Opening Protectives 2016.

G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies 2012.

H. UL 10B - Standard for Fire Tests of Door Assemblies Current Edition, Including All Revisions.

I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies Current Edition, Including All Revisions.

J. WDMA I.S. 1A - Interior Architectural Wood Flush Doors 2013.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.

C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.

D. Samples: Submit two samples of door veneer, 6 by 6 inches in size illustrating wood grain, stain color, and sheen.

E. Test Reports: Show compliance with specified requirements for the following:
   1. Sound-retardant doors and frames; sealed panel tests are not acceptable.

F. Prior to fabrication of doors, provide one complete door onsite, for final review of consistency of colors of full grain pattern.

G. Manufacturer's Installation Instructions: Indicate special installation instructions.

H. Warranty, executed in Owner's name.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience. A qualified manufacturer that is certified for chain of custody by FSC-accredited certification body.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Package, deliver and store doors in accordance with specified quality standard.

B. Accept doors on site in manufacturer's packaging. Inspect for damage.

C. Protect doors with resilient packaging sealed with heat shrunk plastic. Do not store in damp or wet areas; or in areas where sunlight might bleach veneer. Seal top and bottom edges with tinted sealer if stored more than one week. Break seal on site to permit ventilation.

D. Do not deliver doors until spaces are enclosed and weathertight, wet work is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.07 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Interior Doors: Provide manufacturer's warranty for the life of the installation.

C. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wood Veneer Faced Doors:
   1. Algoma Hardwoods, Inc. www.algomahardwoods.com/#sle.
   2. Eggers Industries: www.eggersindustries.com/#sle.
   3. Marshfield Door Systems, Inc. www.architectural.masonite.com/#sle.
   4. Western Oregon Door.
   5. Mohawk Doors.
   6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 DOORS AND PANELS

A. Doors: Refer to drawings for locations and additional requirements.
   1. Quality Standard: Custom Grade, Heavy Duty performance, in accordance with WDMA I.S. 1A.
   2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.

B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
   1. Provide solid core doors at each location.
   2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile matching face veneer, and laminated backing at hinge stiles for improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
   3. Pairs: Furnish formed-steel edges and astragals with intumescent seals for pairs of fire-rated doors, unless otherwise indicated.
      a. Finish steel edges and astragals with baked enamel same color as door frame.
   4. Wood veneer facing for field transparent finish as indicated on drawings.

2.03 DOOR AND PANEL CORES

A. Non-Rated Solid Core and 20 Minute Rated Doors: Type structural composite lumber core (SCLC), plies and faces as indicated.

2.04 DOOR FACINGS

A. Wood Veneer Facing for Transparent Finish: Red oak, Veneer grade A, Premium (WDMA), plain sliced, slip veneer match, balance assembly match; unless otherwise indicated. Veneers shall be selected so that lighter than average colors will not be adjacent to darker than average colors, and there will be no sharp contrast in color between the adjacent graining. Select wood veneers so that the color of adjacent veneers is similar and nearly uniform in appearance. The grain figure or other natural character markings shall be similar in appearance. Achieve a good blend of color and tone throughout the project area.
   1. Vertical Edges: Compatible hardwood.
   2. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
   3. Transoms: Continuous match to doors.

B. Facing Adhesive: Type I - waterproof.

2.05 DOOR CONSTRUCTION

A. Fabricate doors in accordance with door quality standard specified.

B. Cores Constructed with stiles and rails:

C. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.

D. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.

E. Provide edge clearances in accordance with the quality standard specified.

2.06 FACTORY FINISHING - WOOD VENEER DOORS

A. Finish work in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
   1. Transparent:
      a. System - 9, UV Curable, Acrylated Epoxy, Polyester or Urethane.
      b. Stain: As selected by Architect.
      c. Sheen: Satin.

B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:

C. Factory finish doors in accordance with approved sample.

D. Seal door top edge with color sealer to match door facing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that opening sizes and tolerances are acceptable.

C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

A. Install doors in accordance with manufacturer's instructions and specified quality standard.

B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.

C. Use machine tools to cut or drill for hardware.

D. Coordinate installation of doors with installation of frames and hardware.

E. Coordinate installation of glazing.

F. Install door louvers plumb and level.

3.03 TOLERANCES

A. Comply with specified quality standard for fit and clearance tolerances.

B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

A. Adjust doors for smooth and balanced door movement.

B. Adjust closers for full closure.

END OF SECTION

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SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall access door and frame units.

B. Ceiling access door and frame units.

1.02 RELATED REQUIREMENTS

A. Section 09 91 23 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

A. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable 2015.

B. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2014.

C. ITS (DIR) - Directory of Listed Products current edition.

D. UL (FRD) - Fire Resistance Directory current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.

C. Shop Drawings: Indicate exact position of each access door and/or panel unit.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

A. Wall-Mounted Units in Wet Areas:
   1. Location: As indicated on drawings.
   2. Material: Steel, hot-dipped zinc, or zinc-aluminum-alloy coated.
   3. Size: 24 inch x 24 inch.
   4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
   5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
   6. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.

B. Ceiling-Mounted Units:
   1. Location: As indicated on drawings.
   2. Material: Steel.
   3. Size - Other Ceilings: 24 inch x 24 inch.
   4. Door/Panel: Hinged, standard duty, with standard key-operated cylinder cam lock and no handle.

2.02 CEILING-MOUNTED UNITS

A. Manufacturers:
   1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
   2. ACUDOR Products Inc: www.acudor.com/#sle.

3. Babcock-Davis: www.babcockdavis.com/#sle.
4. Bauco Access Panel Solutions Inc: www.accesspanelsolutions.com/#sle.
5. Best Access Doors: www.bestaccessdoors.com/#sle.
6. Cendrex, Inc: www.cendrex.com/#sle.
7. Elmdor Stonemen: www.elmdorstoneman.com/#sle.
8. FF Systems, Inc: www.ffsystemsinc.com/#sle.
9. Substitutions: See Section 01 60 00 - Product Requirements.

B. Ceiling-Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
1. Material: Steel.
2. Style: As indicated on drawings.
3. Frames: 16 gage, 0.0598 inch, minimum thickness.
4. Single Steel Sheet Door Panels: 18 gauge minimum thickness.
5. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
    a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
    b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.
6. Steel Finish: Primed.
7. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
8. Door/Panel Size: As indicated on the drawings.
9. Hardware:
    a. Hardware for Fire-Rated Units: As required for listing.
    b. Hinges for Non-Fire-Rated Units: Continuous piano hinge.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings are correctly sized and located.

3.02 PREPARATION

A. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

A. Install units in accordance with manufacturer's instructions.

B. Install frames plumb and level in openings, and secure units rigidly in place.

C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 43 13
ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Aluminum-framed storefront, with vision glass.

B. Aluminum doors and frames.

C. Perimeter sealant.

D. Acoustical Accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.

B. Section 08 42 29 - Automatic Entrances.

C. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.

D. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site 2015.

B. AAMA 501.2 - Field Check of Metal Storefronts, Curtain Walls, and Sloped Glazing Systems for Water Leakage 2009.

C. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems 2014.

D. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.

E. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum 2012.

F. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections 2009.

G. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix) 2015.

H. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.

I. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2014.

J. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric] 2013.

K. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen 2004 (Reapproved 2012).

L. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference 2014.

M. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference 2015.

N. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with installation of other components that comprise the exterior enclosure.

B. Preinstallation Meeting: Conduct a preinstallation meeting minimum one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.

C. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.

D. Design Data: Provide framing member structural and physical characteristics, engineering calculations, and dimensional limitations.

E. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.

F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.

G. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.

1.06 QUALITY ASSURANCE

A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handle products of this section in accordance with AAMA CW-10.

B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.08 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

B. Correct defective Work within a five year period after Date of Substantial Completion.

C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.

D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design:
   1. Exterior Storefront:
      a. Kawneer North America; Product Trifab 451UT . www.kawneer.com
         1) Kawneer IsoLock™ Thermal Break with a 1/4" separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
         2) Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.
      b. Tubelite's T14000.

B. Aluminum-Framed Storefront and Doors:
   1. Exterior Swing Doors: Glazed aluminum.
      a. Basis of Design: Kawneer 350T series Insulpour Thermal Performance Doors.
         1) U-factor: 0.52.
         2) CRF: 49.

3) Thickness: 1-3/4 inches.
4) Medium Stile:
(a) Top Rail: 5 inches wide.
(b) Vertical Stiles: 5 inches wide.
(c) Bottom Rail: 12 inches wide.
5) Glazing Stops: Square.
6) Finish: Same as storefront.

b. Tubelite's Medium Stile Therml=Block.

2. Interior Swing Doors: Glazed aluminum.
a. Basis of Design: Kawneer 350 series.
1) Thickness: 1-3/4 inches.
2) Medium Stile:
(a) Top Rail: 5 inches wide.
(b) Vertical Stiles: 5 inches wide.
(c) Bottom Rail: 12 inches wide.
3) Glazing Stops: Square.
4) Finish: Same as storefront.

b. Tublite's Wide Stile standard doors

C. Other Manufacturer's products if compliant with Specifications:
1. Tubelite, Inc; ____: www.tubeliteinc.com/#sle.
2. Efco Corp; Product Model S-403.

2.02 ALUMINUM-FRAMED STOREFRONT

A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
1. Glazing Position: Front-set.
2. Finish: Class I natural anodized.
a. Factory finish all surfaces that will be exposed in completed assemblies.
3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.

B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
a. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
2. Air Leakage Laboratory Test: Maximum of 0.06 cu ft/min sq ft of wall area, when tested in accordance with ASTM E283 at 6.27 psf pressure differential across assembly.
3. Condensation Resistance Factor (CRF):

a. Front-set style: The glass to exterior CRF, when tested to AAMA Specification 1503, shall not be less than 68_{frame} and 66_{glass} (low-e).
b. Overall U-value Including Glazing: 0.32 Btu/(hr sq ft deg F), maximum.
c. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed.

4. Water Leakage: None, when measured in accordance with ASTM E331 at specified pressure differential.

2.03 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.
2. Glazing Stops: Flush.

B. High performance extruded aluminum sill flashings as detailed on Drawings, finish to match framing members.

C. Accommodate lintel deflection per details on Drawings.

2.04 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Fasteners: Stainless steel.

C. Exposed Flashings: Aluminum sheet, 18 gage, 0.040 inch minimum thickness; finish to match framing members.
1. Provide brake-formed or extruded aluminum shapes indicated on drawings.
2. Provide head receptors as indicated on drawings.

D. Glass: As specified in Section 08 80 00.

E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.

F. Glazing Accessories: As specified in Section 08 80 00.

G. Closed Cell Foam Insulation: Gun-grade, single-component, low-expanding, polyurethane foam joint filler formulated to achieve thermal, sound and air barrier continuity at the perimeter of opening frames in exterior walls.
1. Manufacturers:
a. Tremco; ExoAir LEF: www.tremcosealants.com.
b. Substitutions: See Section 01 60 00 - Product Requirements.
2. Comply with ASTM E-84:
a. Flame Spread: 5.
b. Smoke Development: 30.

H. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.05 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

B. Color: As indicated on drawings.

C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.06 HARDWARE

A. Other Door Hardware: Storefront manufacturer's standard type to suit application.
1. Finish on Hand-Contacted Items: Polished chrome.
2. For each door, include butt hinges, push handle, pull handle, exit device, and closer.

2.07 FABRICATION

A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.

B. Accurately fit and secure joints and corners. Make joints flush, hairline, and weatherproof.

C. Prepare components to receive anchor devices. Fabricate anchors.

D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.

E. Arrange fasteners and attachments to conceal from view.

F. Reinforce components internally for door hardware and door operators.

G. Reinforce framing members for imposed loads.

H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
   1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify dimensions, tolerances, and method of attachment with other work.

B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.02 INSTALLATION

A. Install wall system in accordance with manufacturer's instructions.

B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.

C. Provide alignment attachments and shims to permanently fasten system to building structure.

D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.

E. Provide thermal isolation where components penetrate or disrupt building insulation.

F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.

G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.

H. Fill shim spaces with non-expanding foam sealant at perimeter of assembly to maintain continuity of thermal barrier.

I. Set thresholds in bed of sealant and secure.

J. Install hardware using templates provided.

K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 ADJUSTING

A. Adjust operating hardware and sash for smooth operation.

3.05 CLEANING

A. Remove protective material from pre-finished aluminum surfaces.

B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.

C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.06 PROTECTION

A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 Section "Alternates" for alternates affecting this section.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
   a. "Metal Doors and Frames"
   b. "Flush Wood Doors"
   c. "Aluminum-Framed Entrances and Storefronts"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 1784 - Air Leakage Tests of Door Assemblies
2. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities

2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
   a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
   b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
   a. Wiring Diagrams: For power, signal, and control wiring and including:
      1) Details of interface of electrified door hardware and building safety and security systems.
      2) Schematic diagram of systems that interface with electrified door hardware.
      3) Point-to-point wiring.
      4) Risers.

3. Door Hardware Schedule:
   a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
   b. Submit with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
   c. Indicate complete designations of each item required for each opening, include:
      1) Door Index: door number, heading number, and Architect's hardware set number.
      2) Quantity, type, style, function, size, and finish of each hardware item.
      3) Name and manufacturer of each item.
      4) Fastenings and other pertinent information.
      5) Location of each hardware set cross-referenced to indications on Drawings.
      6) Explanation of all abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for hardware.
      8) Door and frame sizes and materials.
      9) Degree of door swing and handing.
      10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.

4. Key Schedule:

a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.

C. Informational Submittals:

1. Provide Product Data:
   a. Include warranties for specified door hardware.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
   c. Final approved hardware schedule edited to reflect conditions as installed.
   d. Final keying schedule
   e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
   f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

1.04 QUALITY ASSURANCE

A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project’s vicinity.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
   a. Can provide installation and technical data to Architect and other related subcontractors.
   b. Can inspect and verify components are in working order upon completion of installation.

c. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.

4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

B. Certifications:

1. Electrified Door Hardware
   a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

2. Accessibility Requirements:
   a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

C. Pre-Installation Meetings

1. Keying Conference
   a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
      1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
      2) Preliminary key system schematic diagram.
      3) Requirements for key control system.
      4) Requirements for access control.
      5) Address for delivery of keys.

2. Pre-installation Conference
   a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   b. Inspect and discuss preparatory work performed by other trades.
   c. Inspect and discuss electrical roughing-in for electrified door hardware.
   d. Review sequence of operation for each type of electrified door hardware.
   e. Review required testing, inspecting, and certifying procedures.
   f. Review questions or concerns related to proper installation and adjustment of door hardware.

3. Electrified Hardware Coordination Conference:
   a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.

C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.

D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

1.06 COORDINATION

A. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

B. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.

1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    a. Mechanical Warranty
        1) Locks
            a) Schlage ND Series: 10 years
        2) Exit Devices
            a) Von Duprin: 3 years
        3) Closers
            a) LCN 4000 Series: 30 years
        4) Automatic Operators
            a) LCN: 2 years

1.08 MAINTENANCE

A. Turn over unused materials to Owner for maintenance purposes.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."

    1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.

B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.

C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

2.02 MATERIALS

A. Fabrication

    1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
    2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
    3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

    1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

C. Cable and Connectors:

    1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.

2.03 HINGES

A. Manufacturers and Products:

    1. Scheduled Manufacturer and Product:
        a. Ives 5BB series

2. Acceptable Manufacturers and Products:
    a. Hager BB1191/1279 series
    b. McKinney TB series

B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
    a. Exterior: Heavy weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
    b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high

4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
    a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

5. 2 inches or thicker doors:
    a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
    b. Interior: Heavy weight, steel, 5 inches (127 mm) high

6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
    a. Steel Hinges: Steel pins
    b. Non-Ferrous Hinges: Stainless steel pins
    c. Out-Swinging Exterior Doors: Non-removable pins
    d. Out-Swinging Interior Lockable Doors: Non-removable pins
    e. Interior Non-lockable Doors: Non-rising pins

2.04 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
    a. Schlage ND series

2. Acceptable Manufacturers and Products:
    a. No Substitute

B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
    a. Lever Design: Rhodes (RHO).

2.05 EXIT DEVICES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Von Duprin 98/35A series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
14. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

2.06 ELECTRIC STRIKES

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. HES 9600 Series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide electric strikes designed for use with type of locks shown at each opening.
2. Provide electric strikes UL Listed as burglary resistant that are tested to a minimum endurance test of 1,000,000 cycles.
3. Where required, provide electric strikes UL Listed for fire doors and frames.

4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.07 CYLINDERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. Schlage Everest

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide cylinders/cores compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset; manufacturer's series as indicated. Refer to "KEYING" article, herein.
2. Provide cylinders in the below-listed configuration(s), distributed throughout the Project as indicated.
   a. Patented Restricted: cylinder with permanent core with patented, restricted keyway.

3. Patent Protection: Cylinders/cores requiring use of restricted, patented keys, patent protected.
4. Nickel silver bottom pins.

2.08 KEYING

A. Scheduled System:

1. Existing factory registered system:
   a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:

1. Permanent Keying:
   a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      1) Master Keying system as directed by the Owner.
   b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   c. Provide keys with the following features:
      1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
      2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
   d. Identification:
      1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
      2) Identification stamping provisions must be approved by the Architect and Owner.

3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

e. Quantity: Furnish in the following quantities.
1) Change (Day) Keys: 2 per cylinder/core.
2) Master Keys: 6.

2.09 DOOR CLOSERS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
a. LCN 4040XP series

2. Acceptable Manufacturers and Products:
a. No Substitute

B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.10 ELECTRO-HYDRAULIC AUTOMATIC OPERATORS

A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
   a. LCN 4600 series

2. Acceptable Manufacturers and Products:
   a. No Substitute

B. Requirements:

1. Provide low energy automatic operator units with hydraulic closer complying with ANSI/BHMA A156.19.
2. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
3. Provide units with conventional door closer opening and closing forces unless power operator motor is activated. Provide door closer assembly with adjustable spring size, back-check, and opening and closing speed adjustment valves to control door
4. Provide units with on/off switch for manual operation, motor start up delay, vestibule interface delay, electric lock delay, and door hold open delay.
5. Provide drop plates, brackets, and adapters for arms as required for details.
6. Provide actuator switches and receivers for operation as specified.
7. Provide weather-resistant actuators at exterior applications.
8. Provide key switches with LED's, recommended and approved by manufacturer of automatic operator as required for function described in operation description of hardware group below. Cylinders: Refer to "KEYING" article, herein.
9. Provide complete assemblies of controls, switches, power supplies, relays, and parts/material recommended and approved by manufacturer of automatic operator for each individual leaf. Actuators control both doors simultaneously at pairs. Sequence operation of exterior and vestibule doors with automatic operators to allow ingress or egress through both sets of openings as directed by Architect. Locate actuators, key switches, and other controls as directed by Architect.
10. Provide units with vestibule inputs that allow sequencing operation of two units, and SPDT relay for interfacing with latching or locking devices.

2.11 PROTECTION PLATES

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

2.12 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

A. Manufacturers:

1. Scheduled Manufacturers:
   a. Glynn-Johnson

2. Acceptable Manufacturers:
   a. Rixson
   b. ABH

B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.
2. Provide friction type at doors without closer and positive type at doors with closer.

2.13 DOOR STOPS AND HOLDERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Trimco
   b. Rockwood

B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

2.14 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Zero International

2. Acceptable Manufacturers:
   a. National Guard
   b. Pemko

B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

2.15 SILENCERS

A. Manufacturers:

1. Scheduled Manufacturer:
   a. Ives

2. Acceptable Manufacturers:
   a. Rockwood
   b. Trimco

B. Requirements:

1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

2.16 FINISHES

A. FINISH: As specified in the hardware sets.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
4. Installation Guide for Doors and Hardware: DHI TDH-007-20

B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.

D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.

I. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Connections to panel interface modules, controllers, and gateways.
6. Testing and labeling wires with Architect's opening number.

J. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

K. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

L. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

M. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

N. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

O. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

   1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
   2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.04 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items per manufacturer's instructions to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.05 DOOR HARDWARE SCHEDULE

A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

OPT0334137 Version 1

Legend:
Link to catalog cut sheet
Electrified Opening

Hardware Group No. 01
For use on Door #(s):

117-2	117A	117B	119A	120-1	120A
120B	123A	129-1	129-2	129B	131-2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
1	EA	GASKETING	488S @ HEAD & JAMBS		BK	ZER

Hardware Group No. 02
For use on Door #(s):

122-2

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	PASSAGE SET	ND10S RHO		626	SCH
1	EA	OH STOP	90S		630	GLY
1	EA	GASKETING	488S @ HEAD & JAMBS		BK	ZER

Hardware Group No. 03
For use on Door #(s):

134G 172A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	PRIVACY LOCK	ND40S RHO		626	SCH
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
1	EA	GASKETING	488S @ HEAD & JAMBS		BK	ZER

Hardware Group No. 04
For use on Door #(s):

135 136 171C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 05
For use on Door #(s):

117-1	119	120-2	122-1	123	129-3
131-1	132	133	134	134B	142

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	ENTRANCE LOCK	ND53P6D RHO		626	SCH
1	EA	SURFACE CLOSER (W/ HOLD OPEN)	4040XP HEDA TBWMS		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 06
For use on Door #(s):

134F 171B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	CLASSROOM LOCK	ND70P6D RHO		626	SCH
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 07
For use on Door #(s):

122B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	CLASSROOM LOCK	ND70P6D RHO		626	SCH
1	EA	OH STOP	90S		630	GLY
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 08
For use on Door #(s):

121 130

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 09
For use on Door #(s):

127

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	SURFACE CLOSER (W/ HOLD OPEN)	4040XP HEDA TBWMS		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
1	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 010
For use on Door #(s):

118

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
1	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	STOREROOM LOCK	ND80P6D RHO		626	SCH
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 011
For use on Door #(s):

110A-1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	DUMMY PUSH BAR	350		626	VON
1	EA	DUMMY PUSH BAR & DOOR PULL	350-990DT		626	VON
2	EA	SURFACE CLOSER	4040XP EDA TBWMS		689	LCN
2	EA	KICK PLATE	8400 12" X 1" LDW B-CS		630	IVE
2	EA	WALL STOP	WS406/407 (CCV OR CVX AS REQ'D)		630	IVE
2	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 012
For use on Door #(s):

110A-2
Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	SET	EXTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		630	IVE
1	EA	REMOVABLE MULLION	KR4854B STAB - LESS STRIKE PREP		689	VON
1	EA	PANIC HARDWARE	98-EO-SNB		626	VON
1	EA	PANIC HARDWARE	98-NL-SNB		626	VON
1	EA	MORTISE CYLINDER	20-001 X L583-477		626	SCH
1	EA	RIM CYLINDER	20-022		626	SCH
1	EA	ELECTRIC STRIKE	9600 SERIES		630	HES
2	EA	SURFACE CLOSER (W/ STOP)	4040XP CUSH TBWMS		689	LCN
2	EA	KICK PLATE	8400 12" X 2" LDW B-CS		630	IVE
1	SET	GASKETING SET	429AA-S @ HEAD & JAMBS		AA	ZER
1	EA	MULLION SEAL	8780N		BK	ZER
2	EA	DOOR SWEEP	39A		A	ZER
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL		A	ZER
1	EA	LOW VOLTAGE POWER*	PROVIDED BY SECURITY VENDOR			
1	EA	CARD READER*	PROVIDED BY SECURITY VENDOR			
2	EA	DOOR POSITION SWITCH	679 / 7764 AS REQ'D			SCE
1	EA	REQUEST TO EXIT*	PROVIDED BY SECURITY VENDOR			
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	BY HARDWARE SUPPLIER			

FREE EGRESS AT ALL TIMES.
VALID CREDENTIAL MOMENTARILY RELEASES ELECTRIC STRIKE, ALLOWING ENTRY.
DOOR CONTACT MONITORS WHEN DOOR OPENS AND CLOSES.
MOTION SENSOR ACTS AS REX SWITCH AND SHUNTS THE DOOR CONTACT TO ALLOW FOR AUTHORIZED EGRESS.
ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS LATCHED. TRIM REMAINS SECURE.
OPENING REQUIRES INTEGRATION WITH ACCESS CONTROL SYSTEM.

Hardware Group No. AL-01
For use on Door #(s):

116-2

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
2	SET	INTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)		652	IVE
1	EA	DUMMY PUSH BAR	350		626	VON
1	EA	DUMMY PUSH BAR & DOOR PULL	350-990DT		626	VON
1	EA	OH STOP	90SE (USE W/ AUTO OP)		630	GLY
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4040XP SCUSH TBWMS		689	LCN
1	SET	CLOSER BRACKET(S)	AS REQ'D TO INSTALL CLOSER		689	LCN
1	EA	SURF. AUTO OPERATOR	4642 TBWMS 120 VAC (FLUSH CEILING MOUNT)		689	LCN
2	EA	4.75" HARDWIRED SQUARE ACTUATOR, TOUCH	8310-853T		630	LCN
2	EA	MOUNT BOX	8310-867F / 8310-867S			LCN
1	SET	SEALS	BY ALUM DOOR/FRAME MFG.			

AUTO OPERATOR REQUIRES 120 V CONNECTION.
PUSH / PULL OPERATION.
ACTUATORS & AUTOMATIC OPERATOR ALWAYS ENABLED.
FREE EGRESS AT ALL TIMES.

Hardware Group No. AL-02
For use on Door #(s):

116-1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER			FINISH	MFR
2	SET	EXTERIOR BALL BEARING HINGE	5BB1 (SIZE, QTY, WEIGHT, NRP AS REQ'D)			630	IVE
1	EA	REMOVABLE MULLION	KR4854B STAB - LESS STRIKE PREP			689	VON
1	EA	PANIC HARDWARE	98-EO-SNB			626	VON
1	EA	PANIC HARDWARE	98-NL-SNB			626	VON
1	EA	MORTISE CYLINDER	20-001 X L583-477			626	SCH
1	EA	RIM CYLINDER	20-022			626	SCH
1	EA	ELECTRIC STRIKE	9600 SERIES			630	HES
1	EA	OH STOP	90SE (USE W/ AUTO OP)			630	GLY
1	EA	SURFACE CLOSER (W/ SPRING STOP)	4040XP SCUSH TBWMS			689	LCN
1	SET	CLOSER BRACKET(S)	AS REQ'D TO INSTALL CLOSER			689	LCN
1	EA	SURF. AUTO OPERATOR	4642 TBWMS 120 VAC (FLUSH CEILING MOUNT)			689	LCN
1	EA	WEATHER RING	8310-801				LCN
2	EA	4.75" HARDWIRED SQUARE ACTUATOR, TOUCH	8310-853T			630	LCN
2	EA	MOUNT BOX	8310-867F / 8310-867S				LCN
1	EA	MULLION SEAL	8780N			BK	ZER
1	SET	SEALS	BY ALUM DOOR/FRAME MFG.				
2	EA	DOOR SWEEP	BY ALUM DOOR/FRAME MFG.				
1	EA	THRESHOLD	655A - OR AS REQUIRED BY SILL DETAIL			A	ZER
1	EA	LOW VOLTAGE POWER*	PROVIDED BY SECURITY VENDOR				
1	EA	CARD READER*	PROVIDED BY SECURITY VENDOR				
2	EA	DOOR POSITION SWITCH	679 / 7764 AS REQ'D				SCE
1	EA	REQUEST TO EXIT*	PROVIDED BY SECURITY VENDOR				
1	SET	WIRING, PT TO PT DIAGRAM & ELEVATION DIAGRAM	BY HARDWARE SUPPLIER				

AUTOMATIC OPERATOR REQUIRES 120V.

FREE EGRESS AT ALL TIMES.
DURING OPEN HOURS: EXTERIOR ACTUATOR IS ENABLED AND DOORS CAN BE DOGGED FOR PUSH / PULL OPERATION. OPERATION CAN BE MODIFIED PER THE SCHOOL'S REQUIREMENTS.
DURING CLOSED HOURS:: VALID CREDENTIAL MOMENTARILY ENABLES EXTERIOR ACTUATOR AND RELEASES ELECTRIC STRIKE, ALLOWING ENTRY. MECHANICAL KEY OVERRIDE AVAILABLE. IF DOOR IS LATCHED WHEN ENABLED ACTUATOR IS DEPRESSED, OPERATOR RELEASES ELECTRIC STRIKE PRIOR TO OPENING.
DOOR CONTACT MONITORS WHEN DOOR OPENS AND CLOSES.
MOTION SENSOR ACTS AS REX SWITCH AND SHUNTS THE DOOR CONTACT TO ALLOW FOR AUTHORIZED EGRESS.
OPENING REQUIRES INTEGRATION WITH ACCESS CONTROL SYSTEM.
ON LOSS OF POWER, ELECTRIFIED HARDWARE IS DISABLED. DOOR IS LATCHED. TRIM REMAINS SECURE.

Door Index Legend:
↯ Electrified Opening

Door#	HwSet#
110A-1	011
110A-2↯	012
116-1↯	AL-02
116-2↯	AL-01
117-1	05
117-2	01
117A	01
117B	01
118	010
119	05
119A	01
120-1	01
120-2	05
120A	01
120B	01
121	08
122-1	05
122-2	02
122B	07
123	05
123A	01
127	09
129-1	01
129-2	01
129-3	05
129B	01
130	08
131-1	05
131-2	01
132	05
133	05
134	05
134B	05
134F	06
134G	03
135	04
136	04
142	05
171B	06
171C	04
172A	03

END OF SECTION

SECTION 08 80 00
GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glazing units.

B. Glazing compounds and accessories.

1.02 RELATED REQUIREMENTS

A. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.

B. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.

C. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.

1.03 REFERENCE STANDARDS

A. OSHA 1910.28(b)(3)(i)(A) - Occupational Safety and Health Standards, Duty to Have Fall Protection and Falling Object Protection, Skylight Cover.

B. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials current edition.

C. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test 2010.

D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2011).

E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2014.

F. ASTM C1036 - Standard Specification for Flat Glass 2016.

G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass 2014.

I. ASTM C1193 - Standard Guide for Use of Joint Sealants 2013.

J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2015.

K. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials 2015.

L. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2012a.

M. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.

N. GANA (GM) - GANA Glazing Manual 2009.

O. GANA (SM) - GANA Sealant Manual 2008.

P. GANA (LGRM) - Laminated Glazing Reference Manual 2009.

Q. ICC (IBC) - International Building Code 2015.

R. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use 1990 (2004).

S. ITS (DIR) - Directory of Listed Products current edition.

T. NFRC 100 - Procedure for Determining Fenestration Product U-factors 2014.

U. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence 2014.

V. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems 2014.

W. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data on Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.

C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.

D. Samples: Submit two samples 12 by 12 inch in size of glass units.

E. Certificate: Certify that products of this section meet or exceed specified requirements.

F. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with GANA (GM), GANA (SM), GANA (LGRM), and IGMA TM-3000 for glazing installation methods.

B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
   1. An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

D. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
   1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
   2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

E. Single Source Responsibility: Provide materials obtained from one source for each type of insulating glass and glazing product indicated.

F. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.

G. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
   1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

H. Permissible Glass Distortion for Heat Treated and Fully Tempered Glass:
   1. Criteria:
      a. Tolerance of 0.005 inches.
         1) Tolerance for roller wave is a maximum of 0.003" from peak to valley in the center of lites, a maximum of 0.008" within 10.5" of the leading or trailing edge, and maximum 50% of the bow/warp tolerance in ASTM C 1048.

2) Tolerance for localized warp for rectangular glass is 1/32" over any 12", or half of the ASTM C 1048 Standard Specification for Heat-Treated Flat Glass standard of 1/16" over any 12"span.

b. Orient the heat-treated glass so that the roller wave is parallel to the window sill / header.

c. Heat-treated glass shall be free of visible mosaic or pattern optical distortion (as opposed to slight waviness noticeable when viewpoint is moving).

d. Heat-treated glass shall be free of defects caused by roller pick. This includes a defect which causes straight lines on nearby buildings, viewed through the glass, to be fuzzy or pixilated in appearance.

1) Millidiopter requirement of no more than +/- 100.

e. Bow and warp not to exceed 1/2 ASTM C1048 for overall Bow and Warp Tolerances.

2. Manufacturing and Fabrication:

a. Produce all heat-treated glass for project on the same equipment using the same processing parameters.

b. Adjust the heat zones and time sequences to optimize heat absorption in the glass without over-heating.

c. Various low-E coatings, substrates, and furnace configuration will be treated differently, as required to achieve specified results.

d. Adjust quench air flow to flatten glass and to minimize roll wave, center-kink, leading and trailing edge distortion, etc.

e. Monitor output to assure that glass complies with specification.

3. Mock-up and Documentation:

a. A full size mock-up shall be viewed under actual jobsite conditions to evaluate the appearance.

b. Glass fabricator shall provide production measurements to be submitted for this mockup, so that Architect can compare quantifiable data with qualitative visual review.

1.07 MOCK-UPS

A. See Section 01 40 00 - Quality Requirements, for additional mock-up requirements.

1.08 FIELD CONDITIONS

A. Do not install glazing when ambient temperature is less than 40 degrees F.

B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
2. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
3. Glass thicknesses listed are minimum.

B. Vapor Retarder and Air Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure vapor retarder and air barrier.

1. In conjunction with vapor retarder and joint sealer materials described in other sections.

C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:

1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.

3. Solar Optical Properties: Comply with NFRC 300 test method.

2.02 GLASS MATERIALS

A. Float Glass: Provide float glass based glazing unless otherwise indicated.
   1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
   2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
   3. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.

B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
   1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class A or 16 CFR 1201 - Category II impact test requirements.
   2. Polyvinyl Butyral (PVB) Interlayer: 0.030 inch thick, minimum.

2.03 INSULATING GLASS UNITS

A. Manufacturers:
   1. Guardian Glass, LLC; _____: www.guardianglass.com/#sle.
   2. Viracon, Apogee Enterprises, Inc; _____: www.viracon.com/#sle.
   3. Vitro Architectural Glass (formerly PPG Glass); _____: www.vitroglazings.com/#sle.

B. Insulating Glass Units: Types as indicated.
   1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
   2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
   3. Warm-Edge Spacers: _____.
      a. Spacer Width: As required for specified insulating glass unit.
      b. Spacer Height: 0.27 inch.
      c. Manufacturers:
         1) Technoform Glass Insulation; TGI-Spacer: www.glassinsulation.us/#sle.
      d. Spacer Color: Black.
   4. Purge interpane space with argon, hermetically sealed.

2.04 INSULATING GLASS UNIT SCHEDULE

A. **Type IG-1T** - Sealed Insulating, Clear Low-e Glass Vision Units, Fully Tempered.
   1. Same as IG-1A except both inner and outer lights fully tempered in lieu of annealed.

B. **Type IG-5A** - Sealed Insulating, Low-e, Tinted, Glass Vision Units:
   1. Composition:
      a. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
         1) Tint: Guardian Crystal Gray
         2) Coating: Low-E type, Guardian, Sunguard SN68 on the #2 surface.
      b. 1/2-inch argon-filled space.
      c. Inboard Lite: Annealed float glass with 1/4 inch thick, minimum.
      d. Tint: Guardian Clear, 1/4 inch thick.
   2. Total Thickness: 1 inch.
   3. Performance Characteristics:
      a. Total Visible Light Transmittance: 48percent, nominal.
      b. Total Solar Heat Gain Coefficient: 30 percent, nominal.
      c. U-Value:
         1) Winter: 0.29.

C. **Type IG-5T** - Sealed Insulating, Tinted, Low-e Glass Vision Units, Fully Tempered.
   1. Same as IG-5A except both inner and outer lights fully tempered in lieu of annealed.

D. **Type IG-6TL**: 1-inch, Insulating, Tinted, Laminated, Security Safety Glazing.
   1. Composition:
      a. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.

1) Tint: Guardian Crystal Gray
2) Coating: Low-E type, Guardian, Sunguard SN68 on the #2 surface.

b. 1/2-inch argon-filled space.

c. Interior Ply:
1) Two layers of 1/8-inch thick tinted fully tempered glass.
2) Type: Guardian Clear
3) Polyvinyl Butyral (PVB) Interlayer:0.30 inch.

d. Total Thickness: 1 inch.

E. **Type IG-21T**: Between the Glass Blinds: Sealed Insulated Glazing Units with Integral Venetian Mini-Blinds:

1. Manufacturer:
a. BETWEENGLASSBLINDS, 5645 Coral Ridge Drive • #279, Coral Springs • Florida, USA 33076 Tel: 866 466 9525 <http://www.betweenglassblinds.com/>.
b. Obtain integrated glass and blind assemblies from a single manufacturer.

2. Unit Thickness: 1-inch nominal, 1.1875 actual.
a. Exterior glass pane: Clear Tempered 1/4-inch thick.
b. Air space: 11/16-inch air filled.
c. Interior glass pane: Clear Tempered 1/4-inch thick.

3. The use of nominally half-inch wide venetian slat (0.4921-inch) with crowned profile, allows the manufacture of the narrow cavity systems, (SL20C).

4. Blinds: Built-In horizontal (6010-T8 aluminum alloy) Venetian mini-blind slats controled each side with a magnetic slide controller, tilt control only, attached to the internal glass in the unit using a designated guide. A pair of rotational magnets - one inside the glass cavity, the other outside - directly controls the movement of the integral blind. By using this system of magnetic force the unit's seal(s) is not compromised, and its integrity is fully maintained.

5. Blinds are assembled and permanently sealed within the double glazing cavity. Once sealed in this totally dust free environment, the blinds require no cleaning.

6. Factory-assembled units, consisting of glass, sealed panes separated by dehydrated interspaces, qualified according to ASTM E 2190.

7. Color of Blinds: As selected by the Architect from the manufacturers standard selections.
a. Hunter Douglas B.V developed the new paint treatment Clarion for ScreenLine which guarantees its performance even at elevated temperatures. This prevents paint contamination of the internal glass surfaces (fogging).

8. Warranty: Furnish manufacturer's 10 year warranty providing for replacement of defective integrated glass and blind assemblies.

2.05 MONOLITHIC GLASS UNIT SCHEDULE

A. **Type S-1T** series - Single Safety Glazing: Non-fire-rated.

1. Application: Provide this type of glazing in the following locations:
a. Glazed sidelights to doors, except in fire-rated walls and partitions.
b. Other locations required by applicable federal, state, and local codes and regulations.
c. Other locations indicated on the drawings.

2. Type: Fully tempered float glass as specified.

3. Tint: Clear.

4. Thicknesses:
a. Type S-1Ta: 1/4-inch minimum, or greater as required by span tables.
b. Type S-1Tb: 1/2-inch minimum, or greater as required by span tables.
c. Type S-1Tc: 3/4-inch minimum, or greater as required by span tables.

B. **Type S-2TL**: Translucent Laminated Glass

1. Two layers of 1/8-inch thick clear tempered glass.

2. Polyvinyl Butyral (PVB) Interlayer:
a. Eastman, Vanceva White Collection, Color by Saflex.
1) St. Louis.

2) 1-877-674-1233.
3) E-mail: support@saflex.com
b. Visible light transmittance: 68 percent.
c. Solar Heat Gain Coefficient (SHGC): 68 percent.
d. Thickness: 0.060 inch thick, minimum.
3. Total thickness: 0.31 inch.

2.06 GLAZING COMPOUNDS

A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-sag, non-staining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; Selected color.

B. Structural-Sealant Joints:
1. Designed to carry gravity loads of glazing.
2. Designed to produce tensile or shear stress of less than 20 psi.
3. Design reviewed and approved by structural-sealant manufacturer.
4. Color: To be selected by Architect from manufacturer’s full range of colors.

2.07 ACCESSORIES

A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.

C. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; black color.

D. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
1. Width: As required for application.
2. Thickness: As required for application.
3. Manufacturers:
a. Tremco Global Sealants: www.tremcosealants.com.

E. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

F. Glazing Clips: Manufacturer's standard type.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.

B. Verify that the minimum required face and edge clearances are being provided.

C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

D. Verify that sealing between joints of glass framing members has been completed effectively.

E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.

B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.

C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.

B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.

D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.

E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.

B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.

C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.

D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 INSTALLATION - WET GLAZING METHOD (COMPOUND AND COMPOUND)

A. Application - Interior Glazed: Set glazing infills from the interior of the building.

B. Install glazing resting on setting blocks. Install applied stop and center pane by use of spacer shims at 24 inch centers, kept 1/4 inch below sight line.

C. Locate and secure glazing pane using glazers' clips.

D. Fill gaps between glazing and stops with glazing compound until flush with sight line. Tool surface to straight line.

3.06 CLEANING

A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.

B. Remove non-permanent labels immediately after glazing installation is complete.

C. Clean glass and adjacent surfaces after sealants are fully cured.

D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.

B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

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SECTION 09 05 61
COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section applies to concrete floor substrates identified in Material Schedule on Drawings to receive the following floor finishes:
   1. Resilient tile and sheet.
   2. Carpet tile.
   3. Thin-set ceramic tile and stone tile.

B. Removal of existing floor coverings.

C. Preparation of existing concrete floor slabs for installation of floor coverings.

D. Testing of concrete floor slabs:
   1. Verify that substrates are ready for finish flooring installation by testing for 1) Bond Testing 2) Alkalinity and Adhesion 3) Moisture 4) dewpoint temperature and 5) ASTM C856 testing.

E. Remedial floor coating work for concrete substrates when one or more concrete substrate for floor finish required tests do not indicate "passing."

F. Patching compound.

1.02 RELATED REQUIREMENTS

A. Section 01 23 00 - Alternates: See Alternate-1, moisture mitigation Work associated with concrete substrates for floor finishes.

B. Section 01 60 00 - Product Requirements.

C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 PRICE AND PAYMENT PROCEDURES

A. Alternates : See Section 01 23 00 - Alternates.
   1. Alternate for Remedial Floor Coating or Sheet Membrane: Do not include the cost of Vapor Control coating in the base bid; state on the bid form the total additional cost for the floor coating, installed, in the event such remediation is required.

1.04 REFERENCE STANDARDS

A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens) 2013.

B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring 2011.

C. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes 2011.

D. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute October 2011.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.06 SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. See Section 01 60 00 - Product Requirements.

C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
   1. Moisture and alkalinity (pH) limits and test methods.

2. Manufacturer's required bond/compatibility test procedure.

D. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
   1. Manufacturer's qualification statement.
   2. Manufacturer's statement of compatibility with types of flooring applied over remedial product.
   3. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
   4. Manufacturer's installation instructions.
   5. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.

E. Testing Agency's Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. All test reports as specified within this Section.
      a. *Architect shall not approve any floor material submittals until all (5) types of test results for concrete substrates and conditioned space have been submitted, "passing".*
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Product data for recommended remedial coating.
   7. Include certification of accuracy by authorized official of testing agency.
   8. Submit report to Architect.
   9. Submit report not more than two business days after conclusion of testing.

F. Adhesive Bond and Compatibility Test Report.

1.07 QUALITY ASSURANCE

A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.

B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
   1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.

C. Contractor's Responsibility Relating to Independent Agency Testing:
   1. Provide access for and cooperate with testing agency.
   2. Confirm date of start of testing at least 10 days prior to actual start.
   3. Allow at least 4 business days on site for testing agency activities.
   4. Achieve and maintain specified ambient conditions.
   5. Notify Architect when specified ambient conditions have been achieved and when testing will start.

D. Remedial Coating Installer Qualifications:
   1. Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 5 years' experience installing moisture emission coatings.
   2. Employ Applicator currently approved by manufacturer, experienced in surface preparation and application of the material and subject to inspection and control of the manufacturer.

E. Install Remedial Coating over properly mechanically prepared concrete surfaces with minimum surface profile of ICRI CSP #3

F. Manufacturer's Qualification
   1. Manufacturer shall have no less than 5 years experience in manufacturing vapor control system. The vapor control system shall be specifically formulated and marketed for vapor and alkalinity control without change of formulation or system design for a minimum period of 5 years.

2. Provide standard 10 year warranty at no additional cost. Applicator of vapor control system shall provide standard installation warranty for quality of installation.
3. Provide Independent lab test reports documenting performance per the following:
    a. ASTM E96, Water Vapor Transmission (dry and wet methods) Performance shall be documented by an independent testing laboratory at a minimum of 90 percent water vapor transmission reduction compared to untreated ACI Committee 201 durable concrete.
    b. ASTM D1308: Insensitivity to alkaline environment up to pH 9.
    c. Certify acceptance to continuous topical water exposure after final cure.
4. Submit list of product use and performance history, for the same formulation and system design, listing reference sources. Similar projects shall have documented minimum initial moisture vapor emission rate (MVER) of 15 lbs. per 1,000 sf per 24 hrs, and have resulted in maintained MVER equal to or less than 3 lbs. per 1,000 sf per 24 hrs when tested to ASTM F1869-98 or an RH value of 95 percent or less when measured per ASTM F2170.

1.08 SCHEDULING

A. Coordinate testing with the Owner and allow enough time to test, submit and install the vapor control system before installation of floor finish.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the job site in their original unopened containers, clearly labeled with manufacturer's name and brand designation.
    1. Include installation instructions.
B. See Section 01 60 00 - Product Requirements, Storage and Protection.
C. Store products in an approved ventilated dry area; protect from dampness, freezing, and direct sun light in areas with temperature range between 50 and 90 degrees F.

1.10 FIELD CONDITIONS

A. Observe basic rules for working with epoxy and concrete.
B. Do not apply moisture vapor reduction system to unprotected surfaces or when water is accumulated on the surface of the concrete.
C. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
D. Install quickly if substrate and job site conditions are above 70 degrees F.
E. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.
F. Allow continuous ventilation and indirect air movement at all times during application and curing process of the water vapor reduction system.

PART 2 PRODUCTS

2.01 MATERIALS

A. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
B. Prohibited material content: See Section 01 60 00 - Product Requirements.
C. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
    1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
    2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
D. Remedial Floor Coating Product:
    1. Provide epoxy-based vapor control system from a single manufacturer:

a. Koster VAP 1 2000 System by Koster American Corporation; (757) 425-1206
b. Ardex Moisture Control system.
c. Bostik Slab-Cote Extreme Moisture Vapor Barrier Coating

2. Sand: Fine sand less than 1/50 of an inch in grain size or 98.5 percent passing sieve size #35.
3. Aggregate: Well graded, washed gravel, 1/8 inch to 1/4 inch or larger.
4. Water for mixing the cementitious materials shall be clean, potable, and sufficiently cool (not warmer than 70 degrees F).
5. Mix Designs: Use clean containers and mix thoroughly per Manufacturer's written requirements to obtain a homogeneous mixture.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

A. Perform following operations in the order indicated:
1. Preliminary Cleaning.
2. Specified Testing.
3. Specified remediation, if required.
4. Patching, smoothing, and leveling, as required.
5. Other preparation specified.
6. Adhesive bond and compatibility test.
7. Protection.

B. Remediations:
1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

A. All pre-existing floor finishes and adhesives, indicated to be removed, shall be mechanically removed prior to installing the new flooring material.

B. Do not use any chemical adhesive removers or solvents.

C. Comply with "Resilient Floor Covering Institute (RFCI, Recommended Work Practices for Removal of Existing Resilient Flooring" for best work practices.

D. Comply with local, State, and federal regulations as applicable to floor covering being removed.

E. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

F. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 EXAMINATION OF CONCRETE SUBSTRATES

A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.

B. Testing: Verify that substrates are ready for resilient flooring installation by testing for 1) Adhesive Bond Testing 2) Alkalinity and Adhesion 3) Moisture 4) dewpoint temperature as well as 5) ASTM

C856 testing:

1. Complete Adhesive Bond Testing to determine compatibility of the adhesives to the concrete slab, as required by Flooring and Adhesive Manufacturers as well as referenced standards.
    a. To conduct a bond test, select approximately a 3-foot square sample of the exact floor finish product scheduled, and adhere it to the subfloor with the exact adhesive that will be used during installation.
    b. Conduct one bond test for each finish floor material scheduled. Conduct more if recommended by manufacturer's directions.
    c. After 72-hours attempt to remove the sample. If sufficient force must be used to remove the sample, this test is considered "passed".
2. Alkalinity and Adhesion Testing:
    a. Perform tests recommended by manufacturer.
    b. In addition, test for alkalinity (pH) per ASTM F-710: Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
        1) Use a wide range alkalinity (pH) test paper. its associated chart, and distilled or deionized water.
        2) Place several drops of water on a clean surface of concrete, forming a puddle approximately 1-inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
        3) Allowable readings for Alkalinity are determined by the flooring and adhesive manufacturers *for each product*.
3. Moisture Testing:
    a. Perform moisture testing as recommended by manufacturer.
    b. In addition, test in accordance with ASTM F-2170: Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes.
    c. Use procedure A, one test for every 1,000 square feet.
    d. Document specific test locations, quantity, and a table of readings.
    e. Testing documentation shall be provided to Architect prior to flooring installation.
    f. Allowable readings for moisture are determined by the flooring and adhesive manufacturers for each product.
4. Dewpoint Measurements: Conduct the following measurements:
    a. Room relative humidity.
    b. Use a hygrometer to verify that the room air is not too humid for adhesive to set properly. It may be necessary to set up air movement devices, like fans or blowers, or dehumidifiers, to precondition the room and maintain a proper environment throughout the installation process.
    c. Use a standard thermometer to measure the air temperature of the room.
    d. Use a special thermometer for measuring concrete surface temperature.
    e. Verify that the moisture content of the concrete surface is not too high for adhesive to set properly.
    f. Dewpoint temperature.
5. Perform one ASTM C856 test per floor.
    a. The location shall be identified by The Architect, once the slabs are complete.
        1) Architect shall select a sensitive location where finishing may appear questionable.

3.04 PREPARATION

A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.

B. Remove sub-floor ridges and bumps.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound to achieve smooth, flat, hard surface.

D. Do not fill expansion joints, isolation joints, or other moving joints.

E. At transitions to a significantly thicker floor materials such as ceramic tile, install trowelable leveling compound to produce a uniform and smooth slope of a 3/8” rise within a 12” horizontal dimension.

F. Prohibit traffic until filler is cured.

G. Clean substrate.

3.05 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Comply with requirements and recommendations of floor covering manufacturer.

3.06 PROVISION OF REMEDIAL FLOOR COATING

A. This Work is Associated with an Alternate-1 in the event that one or more of the required tests fail.

B. Comply with requirements and recommendations of coating manufacturer.

C. Clean surfaces to receive moisture vapor reduction system.
   1. Shot blast floors and clean surfaces to remove residue.
      a. Refer to the International Concrete Repair Institute (ICRI), Technical Guideline #03732, "Selecting and Specifying Concrete Surface Preparation for Coatings.
      b. Concrete Surface Profile (CSP) Scale: CSP 3 (light shotblast).
   2. Remove defective materials and foreign matter such as dust, adhesives, leveling compounds, paint, dirt, floor hardeners, bond breakers, oil, grease, curing agents, form release agents, efflorescence, laitance, shot blast bee bees, etc.
   3. Repair cracks, expansion joints, control joints, and open surface honeycombs; fill in accordance with Manufacturer's recommendations.
      a. Moving Joints: Honor expansion and isolation joints up through the Vapor Control System, underlayment and topping.
      b. Saw Cuts, Control Joints and Dormant Cracks: Fill non-moving joints and cracks greater than 1/32 inch with manufacturer recommended product. Allow to cure for a minimum of 16 hours prior to proceeding with the installation of Vapor Control System.
   4. Inform vapor reduction system manufacturer if concrete additives like chlorides or other soluble compounds that can contaminate surfaces have been used in the concrete mix.
   5. Burn off reinforcing fibers, scrape and vacuum.
   6. Remove, after shot blasting, leaving no fibers on concrete surfaces.
   7. Provide uncontaminated, absorptive, sound surface.

D. Test substrates for moisture vapor emissions in accordance with ASTM F1869 or ASTM F2170.

E. Moisture Mitigation Manufacturer’s representative must come to the site and for visual inspection and approval of all onsite conditions and all test results.
   1. They shall provide documented acceptance of concrete.
   2. Full ten-year warranty of total floor system shall include self-leveling compound, primer, adhesives, and floor finish, etc.

F. Adhesion tests:
   1. Verify proper adhesion of flooring adhesives, coatings, and leveling compounds to the final vapor reduction coating system for acceptability. Contact Manufacturer's Representatives for recommendations.

G. Application
   1. Mix and apply Vapor Control System in accord with manufacturer's written instructions.
   2. For installation of resilient flooring directly over the water vapor reduction system, use 100 percent solids adhesives or contact type adhesives with long working times that can be applied to substrates with a maximum pH of 10. Apply contact type adhesives to substrate and allow water to flash off prior to the flooring installation. Test proper adhesion of adhesive to water vapor reduction system prior to installation of entire flooring systems.

3.07 CLEANING

A. Clean tools and equipment immediately after use per manufacturer's recommendations.

B. Remove debris from project site.

END OF SECTION

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SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Metal stud wall framing.

C. Metal channel ceiling framing.

D. Acoustic insulation.

E. Cementitious backing board.

F. Gypsum wallboard.

G. Joint treatment and accessories.

H. Abuse resistant wallboard.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

C. Section 07 21 00 - Thermal Insulation: Z-furring members, insulation, and vapor retarders installed in assemblies that incorporated gypsum board.

D. Section 07 84 00 - Firestopping: Top-of-wall assemblies at fire-resistance-rated walls.

1.03 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2010 (Reaffirmed 2016).

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units 1999 (Reaffirmed 2016).

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board 2015.

D. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members 2014.

E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing 2012.

F. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products 2015.

G. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board 2013.

H. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness 2015.

I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs 2014.

J. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing 2013.

K. ASTM C1280 - Standard Specification for Application of Gypsum Sheathing Board 2013.

L. ASTM C1325 - Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units 2014.

M. ASTM C1396/C1396M - Standard Specification for Gypsum Board 2014.

N. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels 2015.

O. ASTM C1658/C1658M - Standard Specification for Glass Mat Gypsum Panels 2013.

P. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber 2012.

Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

R. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009.

S. ASTM E413 - Classification for Rating Sound Insulation 2010.

T. GA-216 - Application and Finishing of Gypsum Board 2013.

U. GA-226 - Application of Gypsum Board to Form Curved Surfaces; Gypsum Association 2008.

V. ICC (IBC) - International Building Code 2015.

W. UL (FRD) - Fire Resistance Directory current edition.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. Shop Drawings: Submit documentation of structural adequacy of stud gage selections for all lead-lined drywall applications, for each lead thickness required.

D. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.

E. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum three years of experience.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Prohibited material content: See Section 01 60 00 - Product Requirements.

B. Provide completed assemblies complying with ASTM C840 and GA-216.

2.02 METAL FRAMING MATERIALS

A. Manufacturers - Metal Framing, Connectors, and Accessories:
   1. ClarkDietrich: www.clarkdietrich.com/#sle.
   2. Marino: www.marinoware.com/#sle.
   3. Phillips Manufacturing Co: www.phillipsmfg.com/#sle.
   4. CEMCO[<>]: www.cemcosteel.com/#sle.

B. Non-Loadbearing Framing System Components: ASTM C645; (G60 Coating) galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
   1. Studs: C-shaped with knurled or embossed faces.
      a. Minimum Base Metal Thickness: 25 gauge, except at the following conditions that include, but are not limited to:
         1) Where partition height requires heavier section, to accommodate span within L:240 deflection at load of 5 PSF, use heavier stud.
         2) For walls scheduled for ceramic tile: Utilize L/360 deflection at load of 5 PSF.
         3) For walls subject to intermittent exposure to exterior wind conditions such as vestibules, delivery, garages, lobbies: Utilize L/240 deflection at load of 15 PSF.
         4) At jamb openings provide (2) 20 gauge studs, minimum.
         5) At cement backer board, provide 20 gauge studs, minimum.
         6) At lead-lined drywall, provide 20 gauge studs, minimum.

7) Where abuse resistant wallboard is indicated, provide minimum 20 gauge studs at maximum 16 inch on center.
2. Runners: U shaped, sized to match studs.
3. Ceiling Channels: C-shaped.

C. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Minimum Base-Metal Thickness: 0.0179 inch.

D. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.

E. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

F. Suspension System Components
1. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of diameter wire.
2. Hanger Attachments to Concrete:
a. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
b. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
3. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
a. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
b. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.
4. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
a. Depth: 2”.
5. Grid Suspension System for Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
a. Products: Subject to compliance with requirements, provide one of the following:
1) Armstrong World Industries, Inc.; Drywall Grid Systems.
2) Chicago Metallic Corporation; Drywall Furring System.
3) USG Corporation; Drywall Suspension System.

G. Partition Head To Structure Connections At Non-Fire-Rated Conditions: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI North American Specification for the Design of Cold-Formed Steel Structural Members.

2.03 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
1. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
2. National Gypsum Company: www.nationalgypsum.com/#sle.
3. USG Corporation: www.usg.com/#sle.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
2. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
3. Thickness:

a. Ceilings (Manufactured to have more sag-resistance than regular-type gypsum board): 5/8 inch.

4. Paper-Faced Products:
   a. CertainTeed Corporation; ProRoc.
   b. Georgia-Pacific Gypsum; ToughRock: www.gpgypsum.com/#sle.
   c. National Gypsum Company; Gold Bond Brand Gypsum Wallboard.
   d. USG Corporation; Sheetrock Brand Gypsum Wallboard.
5. Fire Resistant Products:
   a. CertainTeed Corporation; ProRoc Type X.
   b. Georgia-Pacific Gypsum; Fireguard.
   c. National Gypsum Company; Fire-Shield.
   d. USG Corporation; Firecode.
6. Mold Resistant Paper Faced Products:
   a. CertainTeed Corporation; ProRoc Moisture and Mold Resistant.
   b. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com/#sle.
   c. National Gypsum Company; Gold Bond XP.
   d. USG Corporation; Sheetrock Brand Mold Tough.

C. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated on Drawings.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Thickness: 5/8 inch.
   4. Edges: Tapered.

D. Cementitious Backing Board For Wet Areas:
   1. Application: Surfaces behind tile.
   2. Application: Horizontal surfaces behind tile in wet areas.
   3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 5/8 inch.
      b. Products:
         1) CertainTeed Corporation; GlasRoc Tile Backer.
         2) Georgia-Pacific Gypsum; DensShield Tile Backer.
         3) National Gypsum Company; PermaBase.
         4) USG Corporation ; Durock NexGen.

E. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Type X Thickness: 5/8 inch.
   3. Edges: Tapered.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
   1. Material: Galvanized steel sheet for general use and rolled zinc for wet areas.
   2. Shapes:
      a. Cornerbead.
      b. LC-Bead: J-shaped; exposed long flange receives joint compound.
      c. L-Bead: L-shaped; exposed long flange receives joint compound.
      d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
      e. Expansion (control) joint: V-shaped; exposed long flange receives joint compound.

B. Aluminum Trim: Extruded accessories of profiles and dimensions as indicated on Drawings.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Fry Reglet Architectural Metals: fryreglet.com.
2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.
a. Finish: Class II clear anodic finish.
3. See Drawings for dimensions and profiles of aluminum trim (Fry Regel Corp. Product Numbers):
a. Aluminum "Reveal Base" Trim, Fry Reglet Corp., Product No. DRMB-625-400.
b. http://fryreglet.com/downloads_shapefinder/RevealBaseMolding.pdf

2.05 ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 3.5 inch min.

B. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.

C. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
1. Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
2. Ready-mixed vinyl-based joint compound.

D. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

E. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

F. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 FRAMING INSTALLATION

A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.

B. Suspended Ceilings and Soffits: Space framing and furring members as indicated.
1. Level ceiling system to a tolerance of 1/1200.
2. Do not attach hangers to steel roof deck.
3. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
4. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
5. Do not connect or suspend steel framing from ducts, pipes, or conduit.
6. For suspended fire rated assemblies, comply with suspension system and securement details of referenced UL rated assemblies.

C. Studs: Space studs at 16 inches on center unless noted otherwise and at 24 inches on center for shaft wall construction.
1. Extend partition framing to structure where indicated and to ceiling in other locations.
2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

1. Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant.
2. Install acoustical sealant at both faces of partitions at perimeters and through penetrations.
3. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

3.04 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
   1. At shower stall walls, install 15# felt between the studs and the tile backer board as a water and vapor retardant membrane as recommended by the appropriate Tile Council of America assembly.

C. Installation on Metal Framing: Use screws for attachment of gypsum board except face layer of nonrated double-layer assemblies, which may be installed by means of adhesive lamination.

D. Curved Surfaces: Apply gypsum board to curved substrates in accordance with GA-226.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
   1. Not more than 30 feet apart on walls and ceilings over 50 feet long.
   2. At exterior soffits, not more than 30 feet apart in both directions.
   3. Install control joints according to the most restrictive requirements of the following reference standards:
      a. ASTM C 840, The Standard Specification for Application and Finishing of Gypsum Board.
      b. GA-216, the Gypsum Association Recommended Specification for Application and Finishing of Gypsum Board.
      c. At least two weeks prior to installation of gypsum board, at a regularly scheduled Contractor/Architect meeting, Obtain from the Architect guidelines for the design intent of specific control joint locations for visual effect. This is in addition to the following minimum requirements:
         1) Control joints are recommended at door jambs, extending from door head to ceiling.
         2) Include breaking the gypsum board behind the control joint.
         3) Separate framing members should be used on each side of the control joint.
         4) Install a control joint where ever dissimilar construction meets.
         5) Install a control joint to separate the wings of “L”, and “T” shaped ceiling areas.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.06 REMOVAL OF EXISTING WALLCOVERINGS AND ASSOCIATED PREPARATION FOR FINISHES

A. Use very coarse sandpaper.

B. Soak the wallcovering with removal mixture.
   1. Use a stripping chemical mixed in warm water.
   2. Use a warm-water spray to loosen the adhesive.
   3. Moisture must saturate the paste film for at least 20 minutes to fully loosen wallcovering.

C. Clean surfaces thoroughly and rinse.

D. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

E. Prparation of Gypsum Board Surfaces to be Painted after Removal of Existing Wall Paper:
   1. Return surfaces to like-new smoothness.
   2. Fill any small holes, dents or cracks in the surface with joint compound.

3. Apply compound to the holes with a putty knife, then use the knife to scrape off the excess.
4. If the walls are so damaged or pitted after removing the wallpaper that filling each individual hole with joint compound isn't practical, skim coat the wall instead.
5. Thin some joint compound until it is spreadable, and roll it onto an area of the wall with a roller.
6. Use the blade of a squeegee to smooth the compound and remove all the excess, so it fills the dents and leaves a thin film over the rest of the wall section.
7. Repeat the process with the rest of the wall, still working in sections.
8. Allow the compound to dry, and apply a second and third coat if necessary.

3.07 JOINT TREATMENT

A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.

B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface at the following locations (except where surfaces are to be finished with wall covering):
      a. Exposed ceiling, soffit, or wall areas abutting window mullions, skylights, or receiving direct indoor lighting.
      b. Wall-board scheduled to be finished with semi-gloss, gloss, epoxy paint, or high build glazed coating.
      c. Fiberglass coated glass mat, both faces.
      d. Long hallways or corridors.
      e. Atriums, Lobbies, Auditoriums and similar large spaces.
      f. All interior surfaces where PT-19, dry erase surface, is scheduled.
   2. Level 2: In utility areas, behind cabinetry, on backing board to receive tile finish, ceiling plenum areas, concealed areas, including fire-resistance-rated assemblies and sound-rated assemblies. Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated
   3. Level 1: Fire rated wall

C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

D. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.08 PARTITION IDENTIFICATION

A. Comply with adopted edition of IBC, Chapter 7, Marking and Identification.

B. Where there is an accessible concealed floor, floor-ceiling or attic space, fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions or any other wall required to have protected openings or penetrations shall be effectively and permanently identified with stenciling in the concealed space.

C. Identify all walls and partitions of every type of construction (including CMU, poured concrete, etc.) that are indicated on Life Safety Drawings as having a required fire or smoke rating.
   1. Location:
      a. Both sides of partition.
      b. 6-inches above ceiling line.
      c. Within 15-feet of the end of each wall.
      d. At intervals not exceeding 30-feet measured horizontally along the wall or partition.
      e. Above access panels in hard ceilings.
   2. Stenciled Lettering:
      a. Arial Font.
      b. Not less than 3-inches in height.
      c. Minimum stroke of 3/8-inch.
   3. Indicate the end of a rated wall with a 2-inch vertical line with an arrow pointing to the direction of the rated wall.

4. Colors: Per legend on Project Life Safety Diagram and using standard spray paint colors as follows:
    a. 4-HOUR FIRE WALL
        1) Rust-Oleum Safety Purple V2167838
    b. 3-HOUR FIRE WALL
        1) Rust-Oleum Safety Purple V2167838
    c. 2-HOUR FIRE WALL
        1) Rust-Oleum Safety Purple V2167838
    d. 2-HOUR FIRE BARRIER
        1) Rust-Oleum OSHA Safety Red 1660830
    e. 2-HOUR FIRE BARRIER (BEYOND)
        1) Rust-Oleum OSHA Safety Red 1660830
    f. 2-HOUR SHAFT ENCLOSURE
        1) Rust-Oleum OSHA Safety Red 1660830
    g. 2-HOUR SMOKE BARRIER
        1) Rust-Oleum Regal Blue 1622830
    h. 1-HOUR FIRE BARRIER
        1) Rust-Oleum OSHA Safety Orange 1653830
    i. 1-HOUR FIRE BARRIER (BEYOND)
        1) Rust-Oleum OSHA Safety Orange 1653830
    j. 1-HOUR SMOKE BARRIER
        1) Rust-Oleum OSHA Safety Blue 1624830
    k. 1-HOUR SMOKE BARRIER
        1) Rust-Oleum OSHA Safety Blue 1624830
    l. X-X SMOKE TIGHT
        1) Rust-Oleum OSHA Safety Green 1633830
5. Lead Walls: Stencil above the ceiling, both sides of walls lead lined with the height of the lead and the thickness.
    a. Example: "7-feet A.F.F. - 1/16-inch thick lead."
        1) Rust-Oleum OSHA Safety Red 1660830

3.09 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.10 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, and mold damaged.
    1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
    2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 09 30 00
TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Tile for floor applications.

B. Tile for wall applications.

C. Large format tile installations.

D. Solid surface thresholds.

E. Non-ceramic trim.

1.02 RELATED REQUIREMENTS

A. Section 01 23 01 - Alternates: See Alternate-1, moisture mitigation Work associated with concrete substrates for floor finishes.

B. Section 01 60 00 - Product Requirements.

C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

D. Section 03 30 00 - Cast-in-Place Concrete:
   1. Concrete subfloors must be of adequate tensile strength (minimum 200 psi when tested in accordance with ASTM D4541 Method 5).
   2. New poured concrete flooring substrates shall be wet cured with a moisture-retaining curing cover. Chemical curing compounds reduce the drying rate of concrete and can interfere with the adhesive bond.
   3. Specified steps shall be followed to avoid (temporary heating from causing the slab to cure too fast and creating a problem with floor adhesion.)
   4. All newly poured concrete slabs on or below grade shall have a functioning vapor barrier directly under the concrete slab.

E. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.

F. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

G. Section 09 05 61 - Common Work Results for Flooring Preparation:
   1. Removal of existing floor coverings.
   2. Preparation of new and existing concrete floor slabs for installation of floor coverings.
   3. Testing of concrete floor slabs:
      a. Verify that substrates are ready for finish flooring installation by testing for 1) Bond Testing 2) Alkalinity and Adhesion 3) Moisture 4) dewpoint temperature and 5) ASTM C856 testing.
   4. Remedial work for concrete substrates when one or more concrete substrate for floor finish required tests do not indicate "passing."

H. Section 09 21 16 - Gypsum Board Assemblies: Tile backer board.

1.03 REFERENCE STANDARDS

A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium). 2017.

B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar 2014.

C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).

D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement

Mortar Bed with Dry-Set or Latex-Portland Cement 1999 (Reaffirmed 2010).

E. ANSI A108.2 - American National Standard General Requirements: Materials, Environmental and Workmanship 2019.

F. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive 2009 (Revised).

G. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).

H. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy 1999 (Reaffirmed 2010).

I. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout 1999 (Reaffirmed 2010).

J. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout 1999 (Reaffirmed 2010).

K. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework 1999 (Reaffirmed 2010).

L. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units 2010 (Reaffirmed 2016).

M. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior glue plywood) Latex-Portland Cement Mortar 1999 (Reaffirmed 2010).

N. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone 2005 (Reaffirmed 2010).

O. ANSI A108.19 - American National Standard Specifications for Interior Installation of Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs by the Thin-Bed Method Bonded with Modified Dry-Set Cement Mortar or Improved Modified Dry-Set Cement Mortar 2017.

P. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar 2012 (Revised).

Q. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive 2013 (Revised).

R. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar 2012 (Revised).

S. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation 2010 (Revised).

T. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation 2010 (Revised).

U. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation 2014.

V. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-set Ceramic Tile and Dimension Stone Installation 2014.

W. ANSI A136.1 - American National Standard for Organic Adhesives for Installation of Ceramic Tile 2008 (Reaffirmed 2013).

X. ANSI A137.1 - American National Standard Specifications for Ceramic Tile 2013.1.

Y. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. All submittal items of this Section shall be submitted as a single package.
   1. All required product data, samples, shop drawings, and certifications shall be submitted as a complete set.

D. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.

E. Samples:
   1. Two full size units of each type and composition and for each color and finish required.
   2. Full size units of each type of grout, trim, and accessory for each color and finish required.

F. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, ceramic accessories, and setting details.
   1. Assume one pre-installation meeting is required to review shop drawings with field conditions.

G. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
   1. Architect shall not approve any floor material submittals until all (5) types of test results for concrete substrates and conditioned space have been submitted, “passing”.
   2. See Quality Assurance for certification of grout products required for specified temperature range expected at commercial kitchen applications.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.

B. Installer Qualifications:
   1. Company specializing in performing tile installation, with minimum of five years of documented experience.
      a. Accredited Five-Star member of the National Tile Contractors Association (NTCA) or Trowel of Excellence member of the Tile Contractors' Association of America (TCAA).

C. For (LHT) Installations, provide Ten Year System Warranty on primer, underlayment, waterproofing / crack isolation membrane, mortar, and grout.

1.07 DELIVERY, STORAGE, AND HANDLING

A. See Section 01 60 00 - Product Requirements, Storage and Protection.

B. Deliver, store, and handle all material so as to prevent deterioration or the intrusion of any foreign matter.
   1. Deliver material in the original packages.

C. Upon delivery at the construction site, receiver shall verify that packages arrive in a dry condition.
   1. Do not use materials from broken packages or showing evidence of damage.
   2. Verify that tile materials match approved samples within 48 hours of arrival.
      a. Evaluate surface appearance to be free from cracks, chips, dirt, staining, moisture, or mold.
      b. If tile is found to be defective, immediately e-mail written claims to tile supplier with example photographs.
         1) Cost of pick-up, replacement, re-stocking, additonal storage, cleaning per manufacturers instructions, drying, repackaging, handling, and re-delivery (along with fuel surcharges if any) shall be borne by the tile supplier.

D. Tile, once verified to be acceptable, shall be wrapped and stacked on pallets to prevent damage from rising dampness and to prevent contamination by mud, dust, or materials that may cause staining or other defects.
   1. Stacking height, shall be limited to four tile cartons (or less if manufacturer's instructions are more restrictive.)
   2. Store materials in such a manner as not to damage or place undue stress on the structure or component of the building.

3. Cover material to protect from elements and neglect.

E. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.08 FIELD CONDITIONS

A. Do not install solvent-based products in an unventilated environment.

B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 TILE

A. Style, size, and color as indicated on Material Schedule on Drawings.

2.02 TRIM AND ACCESSORIES

A. Non-Ceramic Trim: See Material Schedule on Drawings for each application required.

B. Thresholds: Solid Surface, as scheduled on Drawings, See drawing detail for exact inches wide by full width of wall or frame opening; profile as dimensions on Drawings; without holes, cracks, or open seams.

2.03 TILE SETTING SYSTEMS FOR LARGE AND HEAVY TILES

A. Compatibility: The entire setting system for Large and Heavy Tiles (LHT), including the following components, shall be from the same manufacturer:
   1. Primer.
   2. Underlayment.
   3. Crack isolation and waterproofing membrane.
   4. Mortar.
   5. Grout.

B. The complete setting system for Large and Heavy Tiles (LHT) shall be warranted by one System Installation Warranty:
   1. Materials shall be free from manufacturing defects from the time of purchase and conform to manufacturer’s written specifications under normal usage for a period of ten years when applied according to manufacturer’s written installation instructions and industry standard guidelines. If the nature of the defects of the products specified by this Section warrants, the warranty will include materials and labor for the replacement of the installation.

C. Provide one of the following complete setting systems for Large and Heavy Tiles (LHT):
   1. Laticrete International, Inc.:
      a. Primer: NXT Primer
      b. Cementitious Self-Leveling Underlayment: LATICRETE NXT® LEVEL PLUS
         1) Description:
            (a) Cement-based, free-flowing underlayment for use in leveling interior substrates.
            (b) Rapid setting formula produces a flat, smooth and hard surface for the installation of finished flooring.
            (c) NXT Level Plus can be placed from 1/8–1 1/4" in a single lift.
      c. Waterproofing and Anti-fracture Membrane:
         1) LATICRETE International, Inc; LATICRETE HYDRO BAN:
            (a) Material: Synthetic rubber.
            (b) Thickness: 30 mils, minimum, dry film thickness.
      d. Dry set Mortar for Large and Heavy Tile (LHT).
         1) 4-XLT Rapid.
            (a) Polymer-Modified Mortar complying with ANSI A118.4 & A118.15 (improved performance cement mortar).
            (b) Rapid setting, ready for grouting in less than 4 hours.
            (c) Multi-use, adhesive mortar for non-sag large format wall tile installations and large format tile thin-set applications on floors.

(d) Provides for the complete dispersion of water within the mix, allowing users to achieve the desired application consistency.
(e) Features DUST LOCK™ Technology, reducing onsite mess during mixing.
(f) No shrinkage.
(g) Extra Heavy rating per ASTM C627 (TCNA)
(h) Exceeds ANSI A118.4 and A118.11 Shear Bond Strength Requirements.
(i) Exceeds ISO 12004 C2FTS2 classification.

e. Epoxy Grout for Large and Heavy Tile (LHT)
1) SPECTRALOCK PRO Premium Grout.
(a) Stainproof.
(b) Non-sag formula for walls and floors.
(c) Never needs sealing.
(d) Meets performance requirements of ANSI A118.3 (Epoxy) performance requirements, ISO 13007-3 RG and EN 13888 RG
(e) Anti-microbial technology
(f) Accommodates wide temperature ranges.
(g) Crack resistant.
(h) Use sanded grout.
(i) Colors: See Material Schedule on Drawings.

2. Bostik Inc:
a. Primer: Universal Primer Pro
b. Cementitious Self-Leveling Underlayment: SL-175.
c. Waterproofing and Anti-fracture Membrane: Black-Top.
1) Description: liquid, rubber-based, fabric-reinforced, roller-applied.
2) Exceeds ANSI A118.10 and 118.12.
3) Exceeds ASTM C-386-89.
d. Dry set Mortar for Large and Heavy Tile (LHT):
1) Big Tile & Stone.
(a) Description: Polymer-Modified Large & Heavy Tile Mortar.
(b) Exceeds ANSI A118.4 and A118.11.
(c) Color: White approved for non-sag formulations up to 12” x 24”.
e. Epoxy Grout for Large and Heavy Tile (LHT): Ezpoxy EzClean.

3. MAPEI Corporation:
a. Primer:
1) Eco Prim Plus.
b. Cementitious Self-Leveling Underlayment:
1) Ultrapan 1 plus.
c. Waterproofing and Anti-fracture Membrane:
1) Mapelastic AquaDefense.
d. Dry set Mortar for Large and Heavy Tile (LHT): Two polymer-modified products:
1) Ultraflor Plus for floor applications.
2) Ultraflex LHT for wall applications.
e. Epoxy Grout for Large and Heavy Tile (LHT):
1) Kerapoxy

2.04 SETTING MATERIALS FOR OTHER THAN (LHT)

A. Provide setting materials made by the same manufacturer as grout.
1. Manufacturers:
a. Bostik, Inc.
b. Laticrete International, Inc.
c. MAPEI Corporation

B. Latex Modified-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Basis-of-Design Product: Subject to compliance with requirements, provide the following product or equivalent product by another manufacturer:
   a. Bostik, Inc.; Hydroment Reflex.
2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.
3. Provide product recommended by setting material manufacturer for use over each specific substrate.

2.05 GROUT MATERIALS FOR OTHER THAN (LHT)

A. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
   1. Applications: To be used in all Restroom tile locations.
   2. Products:
      a. Custom Building Products; CEG-IG 100% Solids Industrial Grade Epoxy Grout: www.custombuildingproducts.com/#sle.
      b. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.

B. Select sanded or unsanded grout for applications as follows:
   1. Use sanded grout for:
      a. Floors.
      b. Joints greater than 1/8-inch wide.
      c. Use sanded grout for porcelain and ceramic tile.
   2. Use unsanded grout for:
      a. Walls.
      b. Joints less than 1/8-inch wide.
      c. Use unsanded grout for soft, smooth, stone tile to prevent sand from scrathing the surface.
      d. Use specific unsanded grout products as recommended by glass tile manufacturer.

C. Types:
   1. Standard Grout: Polymer modified cement grout, sanded or unsanded, as specified in ANSI A118.7.
      a. Colors: To be selected by Architect from manufacturer's standard range.
      b. Basis of Design: Latex-Portland Cement Grout.
         1) Bostik, Inc.; Hydroment.
            (a) Bostik Hydroment® Ceramic Tile Grout™ Sanded meets ANSI A118.6 when mixed with water, ANSI A118.7 when mixed with Bostik 425™ Multi-Purpose™ Acrylic Latex Admixtur.
      c. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout. Provide product compatible with grout and as recommended by grout manufacturer.
   2. Premium, Pre-Mixed, Urethane Grout:
      a. Colors: To be selected by Architect from manufacturer's standard range.
      b. Basis-of-Design Product: Subject to compliance with requirements, provide the following product or equivalent product by another manufacturer:
         1) Bostik QuartzLock2™ RapidCure™.
         2) Description: Water-based, water resistant, stain and crack protection, never needs to be sealed.
   3. Water-Cleanable Epoxy Grout: ANSI A118.3.
      a. Colors: To be selected by Architect from manufacturer's standard range.
      b. Basis-of-Design Product: Subject to compliance with requirements, provide the following product or equivalent product by another manufacturer:
         1) Bostik, Inc.; 100% epoxy grout.

2.06 ACCESSORY MATERIALS

A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.

1. Crack Resistance: No failure at 1/8 inch gap, minimum.

B. Waterproofing Membrane: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.
   1. Crack Resistance: No failure at 1/8 inch gap, minimum.
   2. Fluid or Trowel Applied Type:
      a. Material: Synthetic rubber.
      b. Thickness: 30 mils, minimum, dry film thickness.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION:

A. See Section 09 05 61 - Common Work Results for Flooring Examination Preparation Work of that Section.

B. Proceed with installation only after substrates pass testing.
   1. Do not install adhesives or floor coverings when either the air temperature or the concrete surface temperature is within 5 degrees F. above dewpoint temperature.
   2. Do not install flooring over concrete until it has cured, is sufficiently dry to bond well with the adhesive, and the concrete has a pH range recommended by flooring manufacturer.
   3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

C. Verify that required floor-mounted utilities are in correct location.

D. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

F. Protect surrounding work from damage.

3.02 INSTALLATION - GENERAL

A. Install tile and thresholds and grout in accordance with applicable requirements of ANSI A108.1a through ANSI A108.19 , manufacturer's instructions, and TCNA (HB) recommendations.

B. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.

C. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.

D. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.

E. Form internal angles square and external angles bullnosed.

F. Install non-ceramic trim in accordance with manufacturer's instructions.

G. Install thresholds where indicated.

H. Sound tile after setting. Replace hollow sounding units.

I. Keep control and expansion joints free of mortar, grout, and adhesive.

J. Movement Joints:
   1. Comply with 2018 Edition of TCNA EJ171, Movement Joint Guidelines for Ceramic, Glass, and Stone.
   2. Keep expansion joints free of adhesive or grout. Apply sealant to joints.
   3. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

L. Grout tile joints unless otherwise indicated.

M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

N. Apply sealant to junction of tile and dissimilar materials and junction of dissimilar planes.

3.03 INSTALLATION - FLOORS - THIN-SET METHODS

A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with specified grout.
   1. Use uncoupling membrane under all tile unless other underlayment is indicated.
   2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
   3. Where epoxy bond coat and grout are indicated, install in accordance with TCNA (HB) Method F131.

B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.04 INSTALLATION OF LARGE FORMAT TILE

A. Definition of Large Format Tile: Tile with one side greater than 15-inches.

B. Use Dry set Mortar for Large and Heavy Tile (LHT).
   1. This is a product, not an installation method.

C. Floor flatness criteria:
   1. For tiles with at least one edge 15” in length, maximum allowable variation in substrate is 1/8-inch in 10-feet from the required plane, with no more than 1/16” variation in any 24-inches.
   2. The concrete substrate is NOT expected to conform to this flatness criteria so it is the responsibility of tile installer to bring the subsurface into compliance with the desired tolerance by the application of the following:
      a. Primer recommended by underlayment manufacturer.
      b. A flowable and cementitious self-leveling underlayment (SLU) as well as a cement-based patching compound.
      c. Prior to installation of underlayment, the substrate shall be tested to not be in excess of 5 lbs. of water per day per 1000 sq. ft. per ASTM F1869 (calcium chloride) test, or 80% R.H. per ASTM F2170.
      d. Install underlayment within the following ambient temperature conditions:
         1) Above 50° F, and not more than 90° F.
      e. Using the testing procedures outlined in ASTM E1155, floor surfaces covered with a cementitious SLU shall render a minimum f-number of F-50 flatness criteria.
      f. Minimum compressive strength of underlayment: 4000 psi.
      g. Minimum thickness of underlayment: 1/8-inch.
   3. Tile installer shall bring the subsurface into compliance with the desired tolerance.

D. Install waterproofing / crack isolation membrane.

E. Install mortar per ANSI A118.15 the installation for installing tile by the thin-bed method.
   1. Thickness of Dry set Mortar for Large and Heavy Tile (LHT): A range between 3/32-inch to 1/2-inch.
   2. Select trowel so that a minimum coverage of 80% be attained for interior, non-wet areas, and a minimum coverage of 95% be attained for any interior, wet area or any exterior installation.
   3. Curing / Protection.
      a. Use means and methods which accommodate the longer cure time required for large format tile.
   4. Applications:
      a. This application is appropriate to reduce slump factor so edges won’t sink.
      b. This application is NOT appropriate to flatten substrates, form transitions, or slope to drains.

F. Grout joint size:
   1. 1/8-inch for rectified tiles.
   2. 3/16-inch for non-rectified.
   3. Also, the grout joint width shall be at least three times the actual facial variation of the tile.

3.05 INSTALLATION - WALL TILE

A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms, kitchens, locker rooms, and showers.

B. Over interior concrete and masonry install in accordance with TCNA (HB) Method W202, thin-set with dry-set or latex-Portland cement bond coat.

3.06 CLEANING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommendedby tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
   3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

3.07 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.

B. Do not permit traffic over finished floor surface for 4 days after installation.

C. Before final inspection, remove protective coverings.

END OF SECTION

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SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Suspended metal grid ceiling system.

B. Acoustical units.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2013a.

B. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels 2013.

C. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2014.

D. ASTM E1264 - Standard Classification for Acoustical Ceiling Products 2014.

E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth 2015.

F. UL (FRD) - Fire Resistance Directory current edition.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.

B. Do not install acoustical units until after interior wet work is dry.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. Product Data: Provide data on suspension system components and acoustical units.

D. Samples: Submit two samples six by six inch in size illustrating material and finish of acoustical units.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Fire-Resistive Assemblies: Complete assembly listed and classified by UL (FRD) for the fire resistance indicated.

B. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

C. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 FIELD CONDITIONS

A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 ACOUSTICAL UNITS

A. Manufacturers: See Material Schedule on Drawings.
   1. Substitutions: See Section 01 6000 - Product Requirements.

B. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

C. Prohibited material content: See Section 01 60 00 - Product Requirements.

D. Acoustical Units - General: ASTM E1264, Class A.
   1. Units for Installation in Fire-Rated Suspension System: Listed and classified for the fire-resistive assembly as part of suspension system.

2.02 SUSPENSION SYSTEM(S)

A. Manufacturers:
   1. Same as for acoustical units.
   2. Substitutions: See Section 01 6000 - Product Requirements.

B. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

C. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.

D. Suspension system shall typically be prefinished steel, except use aluminum for areas scheduled:
   1. Suspension System:
      a. Dropped Ceiling Track: 15/16".
      b. Main beams: Double-web construction, web height 1 1/2" with rectangular top bulb and 15/16" flange; two fire expansion reliefs.
      c. Cross tees: Double-web construction, web height 1 1/2" with rectangular top bulb and 15/16" flange with cap and override at each end. Stab-type end detail allows cross tee removal without tools.

E. Attachment Devices: Size for five times design load indicated in ASTM C 635, Table 1, Direct Hung, unless otherwise indicated.

2.03 ACCESSORIES

A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.

B. Hanger Wire: 12 gauge, 0.08 inch galvanized steel wire.

C. Perimeter Moldings: Same metal and finish as grid.

D. Where detailed on drawings to provide a transition between ceilings suspended at different heights, provide ceiling grid manufacturer's deep "Trim Channel" with factory miter at bends. Depths as required to accommodate ceiling height steps. Prefinish to match ceiling grid.

E. Acoustical Sealant For Perimeter Moldings: Non-hardening, non-skinning, for use in conjunction with suspended ceiling system.
   1. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
   2. USG Corporation; SHEETROCK Acoustical Sealant.

F. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify that layout of hangers will not interfere with other work.

3.02 INSTALLATION - SUSPENSION SYSTEM

A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, ASTM E580/E580M, ASTM C636/C636M, and ASTM E580/E580M and as supplemented in this section.

B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.

D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
   1. Use longest practical lengths.

E. Suspension System, Non-Seismic: Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.

F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.

G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.

H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.

I. Do not eccentrically load system or induce rotation of runners.

3.03 INSTALLATION - ACOUSTICAL UNITS

A. Install acoustical units in accordance with manufacturer's instructions.

B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.

C. Fit border trim neatly against abutting surfaces.

D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.

E. Cutting Acoustical Units:
   1. Make field cut edges of same profile as factory edges.

F. Where round obstructions occur, provide preformed closures to match perimeter molding.

G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.

H. Install hold-down clips on panels within 20 ft of an exterior door.

3.04 TOLERANCES

A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.

B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

END OF SECTION

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SECTION 09 54 26
SUSPENDED WOOD CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Linear wood planks.

B. Metal suspension system.

1.02 REFERENCE STANDARDS

A. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings 2013a.

B. CISCA (WC) - Wood Ceilings Technical Guidelines 2009.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Shop Drawings: Indicate grid layout and related dimensioning, attachment of wood ceiling components to grid, accessory attachments, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.

C. Product Data: Provide data on wood ceiling components and suspension system components.

D. Samples: Submit two full size samples illustrating material and finish of wood ceiling components.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver wood ceiling components to project site in original, unopened packages.

B. Store in fully enclosed space, flat, level and off the floor.

1.05 FIELD CONDITIONS

A. Do not install suspended wood ceiling system until wet construction work is complete and permanent heat and air conditioning is installed and operating.

B. Maintain room temperature between 60 degrees F and 75 degrees F and relative humidity between 35 to 55 percent before, during, and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Suspended Wood Ceilings:
   1. 9Wood; _____: www.9wood.com/#sle.
   2. Armstrong World Industries, Inc; Woodworks: www.armstrongceilings.com/#sle.
   3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SUSPENDED WOOD CEILING SYSTEM

A. Performance Requirements:
   1. Design for maximum deflection of 1/360 of span.

B. Metal Suspension System:
   1. General: Comply with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
   2. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement.

C. Accessories: Manufacturer's standard accessories for installation method indicated, seismic requirements and above-ceiling accessibility.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not install ceiling until after interior wet work is dry.

3.02 INSTALLATION

A. General: Install suspended wood ceiling system in accordance with CISCA (WC).

B. Wood Ceiling:
   1. Install wood ceilings in accordance with manufacturer's instructions.
   2. Fit wood components in place, free from damaged edges or other defects detrimental to appearance and function.
   3. Install components in uniform plane, and free from twist, warp, and dents.
   4. Cut to fit irregular grid and perimeter edge trim.
   5. Make field cut edges of same profile as factory edges, seal and finish according to manufacturer.
   6. Install clips, stabilizer bars, and other attachments as indicated to secure wood ceiling components tight to the grid system.
   7. Install acoustical backer above wood ceiling components; fit tight between grid members.

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Resilient tile flooring.

B. Resilient base.

C. Installation accessories.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

1.03 REFERENCE STANDARDS

A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2014c.

B. ASTM F1861 - Standard Specification for Resilient Wall Base 2008 (Reapproved 2012).

C. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products; www.baaqmd.gov; 2002.

D. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; Federal Specifications and Standards; Revision E, 1994.

E. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2015.

F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; Resilient Floor Covering Institute October 2011.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.

C. Shop Drawings: Indicate seaming plans and floor patterns.

D. Verification Samples: Submit two samples, 12 by 12 inch in size illustrating color and pattern for each resilient flooring product specified.

E. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of subfloor is acceptable.

1. Architect shall not approve any floor material submittals until all (5) types of test results for concrete substrates and conditioned space have been submitted, “passing”.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.

B. Store all materials off of the floor in an acclimatized, weather-tight space.

C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

D. Protect roll materials from damage by storing on end.

E. Do not double stack pallets.

1.06 FIELD CONDITIONS

A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

B. Maintain temperature in storage area between 55 degrees F and 90 degrees F.

PART 2 PRODUCTS

2.01 TILE FLOORING

A. Vinyl Composition Tile: See Material Schedule on Drawings.

2.02 RESILIENT BASE

A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A, Straight.
   1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
   2. Thickness: 0.125 inch.
   3. Finish: Satin.
   4. Length: Roll. In longest lengths possible.
   5. Color: To be selected by Architect from manufacturer's full range.
   6. Accessories: Premolded external corners and internal corners.
   7. Manufacturers:
      a. Tarkett: www.Tarkett.com.

2.03 ACCESSORIES

A. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION

A. See Section 09 05 61 - Common Work Results for Flooring Examination Preparation Work of that Section.

3.02 INSTALLATION - GENERAL

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install in accordance with manufacturer's written instructions.

C. Spread only enough adhesive to permit installation of materials before initial set.

D. Fit joints and butt seams tightly.

3.03 INSTALLATION - TILE FLOORING

A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.

B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.

C. See Drawings for installation pattern. Allow minimum 1/2 full size tile width at room or area perimeter.

3.04 INSTALLATION - RESILIENT BASE

A. Fit joints tightly and make vertical. Maintain minimum dimension of 36 inches between joints.

B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.

C. Install base on solid backing. Bond tightly to wall and floor surfaces.

D. Scribe and fit to door frames and other interruptions.

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Carpet tile, fully adhered.

1.02 RELATED REQUIREMENTS

A. Section 01 23 01 - Alternates: See Alternate-1, moisture mitigation Work associated with concrete substrates for floor finishes.

B. Section 01 60 00 - Product Requirements.

C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

D. Section 03 30 00 - Cast-in-Place Concrete:
   1. Concrete subfloors must be of adequate tensile strength (minimum 200 psi when tested in accordance with ASTM D4541 Method 5).
   2. New poured concrete flooring substrates shall be wet cured with a moisture-retaining curing cover. Chemical curing compounds reduce the drying rate of concrete and can interfere with the adhesive bond.
   3. Specified steps shall be followed to avoid (temporary heating from causing the slab to cure too fast and creating a problem with floor adhesion.)
   4. All newly poured concrete slabs on or below grade shall have a functioning vapor barrier directly under the concrete slab.

E. Section 09 05 61 - Common Work Results for Flooring Preparation:
   1. Removal of existing floor coverings.
   2. Preparation of new and existing concrete floor slabs for installation of floor coverings.
   3. Testing of concrete floor slabs:
      a. Verify that substrates are ready for finish flooring installation by testing for 1) Bond Testing 2) Alkalinity and Adhesion 3) Moisture 4) dewpoint temperature and 5) ASTM C856 testing.
   4. Remedial work for concrete substrates when one or more concrete substrate for floor finish required tests do not indicate "passing."

F. Section 09 68 16 - Sheet Carpeting: Broadloom carpet.

1.03 REFERENCE STANDARDS

A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.

B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source 2014c.

C. C2C (DIR) - C2c Certified Products Registry; Cradle to Cradle Products Innovation Institute; http:www.c2ccertified.org/products/registry.

D. CRI 104 - Standard for Installation of Commercial Carpet 2015.

E. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action.

F. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action.

G. HPDC (HPD-OLT) - Create an HPD On-Line Tool; Health Product Declaration Collaborative.

H. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures; 2006.

I. ISO 14044 - Environmental management -- Life cycle assessment - Requirements and guidelines; 2006.

J. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source 2015.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.

D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.

E. LEED Report: Submit data documenting VOC content of carpet tile and adhesives; copy of current CRI Approved Products Listing is acceptable.

F. Certification: Prior to installation of flooring, submit written certification by flooring manufacturer and adhesive manufacturer that condition of sub-floor is acceptable.
   1. Architect shall not approve any floor material submittals until all (5) types of test results for concrete substrates and conditioned space have been submitted, “passing”.

G. Manufacturer's Installation Instructions: Indicate special procedures.

H. Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.

B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

A. Comply with CRI 104, Section 5, "Storage and Handling."

B. Store materials in area of installation for minimum period of 24 hours prior to installation.

1.07 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, dimensional stability, and delamination.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. See Material Schedule on Drawings.

2.02 MATERIALS

A. General:
   1. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Prohibited material content: See Section 01 60 00 - Product Requirements.
   3. Manufacture each carpet tile product in one dye lot.
   4. Critical Radiant Flux: Minimum of 0.22 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
   5. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").

B. See Material Schedule on Drawings.

2.03 ACCESSORIES

A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.

B. Edge Strips: Embossed aluminum, color as selected by Architect.

C. Adhesives: Acceptable to carpet tile manufacturer, compatible with materials being adhered; maximum VOC of 50 g/L; CRI Green Label certified; in lieu of labeled product, independent test report showing compliance is acceptable.

PART 3 EXECUTION

3.01 EXAMINATION AND PREPARATION:

A. See Section 09 05 61 - Common Work Results for Flooring Examination Preparation Work of that Section.

B. Proceed with installation only after substrates pass testing.
   1. Do not install adhesives or floor coverings when either the air temperature or the concrete surface temperature is within 5 degrees F. above dewpoint temperature.
   2. Do not install flooring over concrete until it has cured, is sufficiently dry to bond well with the adhesive, and the concrete has a pH range recommended by flooring manufacturer.
   3. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.

C. Verify that required floor-mounted utilities are in correct location.

D. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.02 INSTALLATION

A. Starting installation constitutes acceptance of subfloor conditions.

B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).

C. Carpet Tile Installation
   1. Fully adhered with roll-out wet pressure sensitive adhesive.
      a. This adhesive is used as a releasable or permanent bond.
      b. Furniture placement and heavy traffic should be avoided for at least 24 hours after a direct glue-down installation.
      c. Applications
         1) For general use except not to be used on inclines, ramps, stairs, corridors, or rooms where there will be rolling beds or other heavy rolling loads.
   2. Fully adhered with roll-out wet permanent adhesive.
      a. This adhesive is used for a permanent bond.
      b. Furniture placement and heavy traffic should be avoided for at least 24 hours after a direct glue-down installation.
      c. Applications
         1) To be used on inclines, ramps, stairs, corridors, or rooms where there will be rolling beds or other heavy rolling loads.

D. Lay carpet tile in patterns as scheduled in Material Schedule on Drawings.

E. Blend carpet from different cartons to ensure minimal variation in color match.

F. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.

G. Trim carpet tile neatly at walls and around interruptions.

H. Complete installation of edge strips, concealing exposed edges.

3.03 CLEANING

A. Remove excess adhesive without damage, from floor, base, and wall surfaces.

B. Clean and vacuum carpet surfaces.

C. Protect installed carpet to comply with CRI 104, Section 16, "Protection of Indoor Installations."

D. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION

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SECTION 09 72 00
WALL COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wall covering and borders.

1.02 RELATED REQUIREMENTS

A. Section 01 60 00 - Product Requirements.

B. Section 09 91 23 - Interior Painting: Preparation and priming of substrate surfaces.

1.03 REFERENCE STANDARDS

A. ASTM D1308 - Standard Test Method for Effect of Household Chemicals on Clear and Pigmented Organic Finishes 2002 (Reapproved 2013).

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

C. ASTM F793/F793M - Standard Classifications of Wall Coverings by Use Characteristics; 2015.

D. C2C (DIR) - C2c Certified Products Registry; Cradle to Cradle Products Innovation Institute; http:www.c2ccertified.org/products/registry.

E. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; www.greenscreenchemicals.org.

F. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; www.greenscreenchemicals.org.

G. HPDC (HPD-OLT) - Create an HPD On-Line Tool; Health Product Declaration Collaborative; http://www.hpd-collaborative.org/.

H. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures; 2006.

I. ISO 14044 - Environmental management -- Life cycle assessment - Requirements and guidelines; 2006.

J. FS L-P-1040 - Plastic Sheets and Strips (Polyvinyl Fluoride); Federal Specifications and Standards; Revision B, 1977.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. Product Data: Provide data on wall covering and adhesive.

D. Samples: Submit two samples of wall covering, 8 by 10 inch in size illustrating color, finish, and texture.

E. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.

F. Manufacturer's Installation Instructions: Indicate special procedures.

G. Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Inspect roll materials at arrival on site, to verify acceptability.

B. Protect packaged adhesive from temperature cycling and cold temperatures.

C. Do not store roll goods on end.

1.07 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the adhesive or wall covering product manufacturer.

B. Maintain these conditions 24 hours before, during, and after installation of adhesive and wall covering.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surfaces.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. As indicated on drawings (Material Schedule).

2.02 WALL COVERINGS

A. General Requirements:
   1. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
   2. Prohibited material content: See Section 01 60 00 - Product Requirements.
   3. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.
   4. Chemical and Stain Resistance: No visible staining or discoloration and no damage to surface texture when tested in accordance with ASTM D1308.

B. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:
   1. FS CCC-W-408D and CFFA-W-101 for the following product Type:
      a. Type II, Medium.
   2. ASTM-F793 for peelable or strippable wall coverings that qualify as:
      a. Category IV, Commercial Serviceability.
   3. Backing: Non-woven.

C. Adhesive: Type recommended by wall covering manufacturer to suit application to substrate.

D. Termination Trim: Extruded plastic, clear.
   1. InPro Corporation “NuTree Corner Guard.
   2. Use where wall covering changes color or pattern or terminates at a corner.
   3. Full height, floor to ceiling.
   4. Size: ¾” x ¾” corner.

E. Substrate Filler: As recommended by adhesive and wall covering manufacturers; compatible with substrate.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that substrate surfaces are prime painted and ready to receive work, and comply with requirements of wall covering manufacturer.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply wall coverings if moisture content of substrate exceeds level recommended by wall covering manufacturer.

C. Verify flatness tolerance of surfaces does not vary more than 1/8 inch in 10 feet nor vary at a rate greater than 1/16 inch/ft.

3.02 PREPARATION

A. Fill cracks in substrate and smooth irregularities with filler; sand smooth.

B. Wash impervious surfaces with tetra-sodium phosphate, rinse and neutralize; wipe dry.

C. Surface Appurtenances: Remove or mask electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

D. Surfaces: Correct defects and clean surfaces that affect work of this section. Remove existing coatings that exhibit loose surface defects.

E. Vacuum clean surfaces free of loose particles.

3.03 INSTALLATION

A. Apply adhesive and wall covering in accordance with manufacturer's instructions.

B. Apply wall covering smooth, without wrinkles, gaps or overlaps. Eliminate air pockets and ensure full bond to substrate surface. Butt edges tightly.

C. Horizontal seams are not acceptable.

D. Do not seam within 2 inches of internal corners or within 6 inches of external corners.

E. Install wall covering before installation of bases and items attached to or spaced slightly from wall surface.

F. Install termination trim.

G. Remove excess adhesive while wet from seam before proceeding to next wall covering sheet. Wipe clean with dry cloth.

3.04 CLEANING

A. Clean wall coverings of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

3.05 PROTECTION

A. Do not permit construction activities at or near finished wall covering areas.

END OF SECTION

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SECTION 09 91 13
EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
   5. Floors, unless specifically indicated.
   6. Glass.
   7. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. GreenScreen (LIST) - GreenScreen for Safer Chemicals List Translator; Clean Production Action; www.greenscreenchemicals.org.

B. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; www.greenscreenchemicals.org.

C. HPDC (HPD-OLT) - Create an HPD On-Line Tool; Health Product Declaration Collaborative; http://www.hpd-collaborative.org/.

D. ISO 14025 - Environmental labels and declarations -- Type III environmental declarations -- Principles and procedures; 2006.

E. ISO 14044 - Environmental management -- Life cycle assessment - Requirements and guidelines; 2006.

F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition, www.paintinfo.com.

G. SSPC-SP 13 - Surface Preparation of Concrete; (Reaffirmed 2015). 2003.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements.

C. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

D. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.

1.04 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide paints and finishes from the same manufacturer to the greatest extent possible.

B. Paints:
   1. Base Manufacturer: Sherwin Williams.
   2. PPG Paints: www.ppgpaints.com/#sle.
   3. Hallman Lindsay Paints.

2.02 PAINTS AND FINISHES - GENERAL

A. See Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

B. Prohibited material content: See Section 01 60 00 - Product Requirements.

C. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
   3. Supply each paint material in quantity required to complete entire project's work from a single production run.
   4. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

D. Colors: As indicated in Color Schedule.

2.03 PAINT SYSTEMS - EXTERIOR

A. Paint E-OP - Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete, concrete masonry units, brick, fiber cement siding, primed wood, and primed metal.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Exterior Latex **Flat** (Gloss Level 1); MPI #10.
      a. Products:
         1) Benjamin Moore & Co.; Moorcraft Super Spec 183k183.
         2) Hallman Lindsay Paints; Weather Guard Flat #176
         3) PPG Architectural Finishes; Sun Proof 72-110XI
         4) Sherwin-Williams Company (The); Super Paint Flat
   3. Top Coat(s): Exterior Latex **Low Sheen** (Gloss Level 3-4); MPI #15:
      a. Products:
         1) Benjamin Moore & Co.; Moorcraft Super Spec N185-01
         2) Hallman Lindsay Paints; Weather Guard Lo Sheen #174
         3) PPG Architectural Finishes; Sun Proof 76-110XI.
         4) Sherwin-Williams Company (The); Super Paint Satin
   4. Top Coat(s): Exterior Latex **Semi-Gloss** (Gloss Level 5); MPI #11:
      a. Products:
         1) Benjamin Moore & Co.; Aura Semi Gloss#632
         2) Hallman Lindsay Paints; Weather Guard Satin #172
         3) PPG Architectural Finishes; Sun Proof 78-811XI
         4) Sherwin-Williams Company (The); Super Paint Gloss
   5. Top Coat(s): Exterior Latex **Gloss** (Gloss Level 6); MPI #119:
      a. Products:

1) Benjamin Moore & Co.; Aura Semi Gloss#632
2) Hallman Lindsay Paints; Dura Tech #317 Gloss
3) PPG Architectural Finishes; Pitt-Tech Plus Gloss 90-1310
4) Sherwin-Williams Company (The); Super Paint Gloss

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Alkali Resistant Water Based Primer; MPI #3.
a. Products:
1) Benjamin Moore & Co.; Acrylic Masonry Primer 066.
2) Hallman Lindsay Paints; Grip Tite #166
3) PPG Architectural Finishes; Perma Crete 4-603XI
4) Sherwin-Williams Company (The); Loxon Masonry Primer 24W6300
2. Interior/Exterior Latex Block Filler; MPI #4.
a. Products:
1) PPG Paints Speedhide Masonry Hi Fill Latex Block Filler, 6-15XI. (MPI #4)
2) Benjamin Moore & Co.; Moorcraft Supercraft Latex Blockfiller 285-01.
3) Hallman Lindsay Paints; Fill Kote #179
4) Sherwin-Williams Company (The); Loxon Surfacer A24W00200
3. Anti-Corrosive Alkyd Primer for Metal; MPI #79.
a. Products:
1) Benjamin Moore & Co.; Super Spec HP –PO4/KPO6.
2) Hallman Lindsay Paints; Metal Guard #330 .
3) PPG Architectural Finishes; Multiprime 4160/4360.
4) Sherwin-Williams Company (The); Ken Kromik B50wz1
4. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.
a. Products:
1) PPG Paints Multiprime Multi-Purpose Primer, 4160/4360. (MPI #76)
2) Benjamin Moore & Co.; Super Spec HP –PO4/KPO6.
3) Hallman Lindsay Paints; Metal Guard #330.
4) Sherwin-Williams Company (The); Ken Kromik B50wz1
5. Water Based Primer for Galvanized Metal; MPI #134.
a. Products:
1) Benjamin Moore & Co.; Super Spec HP PO4/KPO6.
2) Hallman Lindsay Paints; Tech Guard #338
3) PPG Architectural Finishes; Pitt-Tech Plus Primer 4020
4) Sherwin-Williams Company (The); DTM Acrylic Primer B66W1
6. Rust-Inhibitive Water Based Primer; MPI #107.
a. Products:
1) Devoe International Coatings, Division of PPG Architectural Finishes; Dev Cryl 1440 Primer/ Finish.
2) Hallman Lindsay Paints; #338 Tech Guard Acrylic DTM
3) PPG Architectural Finishes; Pitt-Tech Primer 90-712.
4) Rust-Oleum; Universal Acrylic DTM Primer
5) Sherwin-Williams Company (The); Pro Cryl Primer B66w310
7. Interior/Exterior Quick Dry Primer for Aluminum; MPI #95.
a. Products:
1) Benjamin Moore & Co.; Super Spec HP –PO4/KPO6.
2) Hallman Lindsay Paints; Tech Guard #338.
3) PPG Architectural Finishes; Multiprime 4160/4360.
4) Sherwin-Williams Company (The); Ken Kromik B50wz1
8. Latex Primer for Exterior Wood; MPI #6.

a. Products:
1) Benjamin Moore & Co.; Fresh Start Acrylic Wood Primer 023/k023.
2) Hallman Lindsay Paints; #112 Acrylic Wood Primer.
3) PPG Architectural Finishes; Seal Grip Primer # 17-921XI
4) Sherwin-Williams Company (The); Exterior Latex wood primer B42w8041

9. Bonding Primer, Water Based; MPI #17.
a. Products:
1) PPG Paints Seal Grip Interior/Exterior Acrylic Universal Primer/Sealer, 17-921XI Series. (MPI #17)
2) Benjamin Moore & Co.; Fresh Start All Purpose Acrylic Primer 023.
3) Hallman Lindsay Paints; Stain Guard #526.
4) Sherwin-Williams Company (The); Adhesion Primer b51W6050
5) XIM Products, Inc., Division of Rust-Oleum; Plastic and Laminate Primer
6) Zinsser, Division of Rust-Oleum; Bullyseye Smart Prime

PART 3 EXECUTION

3.01 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.

F. Concrete:
1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
2. Clean surfaces with pressurized water. Use pressure range of 1,500 to 4,000 psi at 6 to 12 inches. Allow to dry.
3. Clean concrete according to ASTM D4258. Allow to dry.
4. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.

G. Masonry:
1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
2. Prepare surface as recommended by top coat manufacturer.
3. Clean surfaces with pressurized water. Use pressure range of 600 to 1,500 psi at 6 to 12 inches. Allow to dry.

H. Fiber Cement Siding: Remove dirt, dust and other foreign matter with a stiff fiber brush. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.

I. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.

3.02 APPLICATION

A. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.

B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

D. Apply each coat to uniform appearance.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

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SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of paints.

C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

D. Do Not Paint or Finish the Following Items:
   1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
   2. Items indicated to receive other finishes.
   3. Items indicated to remain unfinished.
   4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
   5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
   6. Marble, granite, slate, and other natural stones.
   7. Floors, unless specifically indicated.
   8. Ceramic and other tiles.
   9. Brick, architectural concrete, cast stone, integrally colored plaster and stucco.
   10. Glass.
   11. Concealed pipes, ducts, and conduits.

1.02 REFERENCE STANDARDS

A. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Base Materials 2007.

B. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition, www.paintinfo.com.

C. SSPC-SP 1 - Solvent Cleaning 2015.

D. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. See Section 01 60 00 - Product Requirements, Storage and Protection.

C. Product Data: Provide complete list of products to be used, with the following information for each:
   1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
   2. MPI product number (e.g. MPI #47).
   3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.

D. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
   1. Where sheen is specified, submit samples in only that sheen.
   2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens definitely not required.

1.04 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paints:

2.02 PAINTS AND FINISHES - GENERAL

A. Prohibited material content: See Section 01 60 00 - Product Requirements.

B. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
   1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each paint material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

2.03 PAINT SYSTEMS - INTERIOR

A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, shop primed steel, galvanized steel, aluminum, and acoustical ceilings.
   1. Two top coats and one coat primer.
   2. Top Coat(s): Interior Latex, Flat (Gloss Level 1) MPI #53.
      a. Products:
         1) Benjamin Moore & Co.; ECO Spec WB Flat 373-1x
         2) Hallman Lindsay Paints; Pro Kote Flat Zero #264
         3) PPG Speedhide Zero Interior Latex Flat 6-4110XI
         4) SW Pro Mar 200 Zero VOC Latex Flat B30
   3. Top Coat(s): Interior Latex, (Gloss Level 2) MPI #44
      a. Products:
         1) Benjamin Moore & Co.; Super Spec Latex Pearl 277.
         2) Hallman Lindsay Paints; Pro Kote Flat Lo Sheen #283
         3) PPG Speedhide Zero Interior Latex, Eggshell 6-4310XI
         4) SW Pro Mar 200 Zero VOC Latex Eggshell B41
   4. Top Coat(s): Interior Latex (Gloss Level 3) MPI #52
      a. Products:
         1) Benjamin Moore & Co.; ECO Spec WB Eggshell 374-1x
         2) Hallman Lindsay Paints; Pro Kote Eggshell #284
         3) SW Pro Mar 200 Zero VOC Latex Satin A41
         4) Sherwin-Williams Company (The); Pro Mar 200 Eggshell B24W2651
   5. Top Coat(s): Interior Latex (Gloss Level 4) MPI #43
      a. Products:
         1) Benjamin Moore & Co.; Eco Spec Semi Gloss 376-1x
         2) Hallman Lindsay Paints; Pro Kote Satin #294
         3) PPG Speedhide Interior Latex, Lo Lustre 6-3010
         4) SW Pro Mar 200 Zero VOC Latex Semi Gloss B31
   6. Top Coat(s): Interior Latex, Semi-Gloss (Gloss Level 5) MPI #54
      a. Products:
         1) Benjamin Moore & Co.; Eco Spec Semi Gloss 376-1x
         2) Hallman Lindsay Paints; Pro Kote Semi Gloss #296
         3) PPG Speedhide Zero Interior Latex, Semi Gloss 6-4510XI
         4) SW Pro Mar 200 Zero VOC Latex Semi Gloss B31

7. Top Coat(s): Interior Latex, Gloss (Gloss Level 6) MPI 114
    a. Products:
        1) Benjamin Moore & Co.; Impervex High Gloss Enamel 309
        2) Hallman Lindsay Paints; Duratech Gloss #317
        3) PPG Pitt-Tech Plus Gloss 90-1310
        4) SW Pro Mar 200 Zero VOC Latex Gloss B21

B. Paint I-OP-MD-DT - Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
    1. Two top coats and one coat primer.

C. Paint I-OP-DF - Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
    1. Shop primer by others.
    2. One top coat.
    3. Top Coat: Latex Dry Fall; MPI #118, 155, or 226.
        a. Products:
            1) Benjamin Moore & Co.; Latex Dry Fall 395
            2) Hallman Lindsay Paints; #251 Drop Dry Acrylic Dry Fog
            3) PPG Speedhide Super Tech Interior Latex Dryfall 6-725XI
            4) SW Waterborne Acrylic Dryfall Flat B42
    4. Top Coat: Water Based Dry Fall for Galvanized Steel (Gloss Level 1) MPI #133.
        a. Products:
            1) Benjamin Moore & Co.; Latex Dry Fall 395
            2) Hallman Lindsay Paints; #251 Drop Dry Acrylic Dry Fog
            3) PPG Speedhide Super Tech Interior Latex Dryfall 6-713X
            4) SW Waterborne Acrylic Dryfall Flat B42

2.04 PRIMERS

A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
    1. Alkali Resistant Water Based Primer; MPI #3.
        a. Products:
            1) PPG; Perma Crete 4-603XI
    2. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
        a. Products:
            1) PPG Paints Pure Performance Interior Latex Primer, 9-900. (MPI #149)
            2) Hallman Lindsay Paints; Wall Prep #220 Primer/Sealer
            3) Benjamin Moore & Co.; Natura 511
            4) Sherwin-Williams Company (The); Harmony Latex Primer B11-900
    3. Interior/Exterior Latex Block Filler; MPI #4.
        a. Products:
            1) Benjamin Moore & Co.; Benjamin Moore Block filler 244
            2) Hallman Lindsay Paints; Block Kote #184
            3) PPG Masonry Latex Block Filler #6-15XI
            4) SW PrepRite ProBlock Latex Blockfiller B51
    4. Interior Latex Primer Sealer; MPI #50.
        a. Products:
            1) Benjamin Moore & Co.; Eco Spec- WB Primer 372-00
            2) Hallman Lindsay Paints; Wall Prep #220 Primer/Sealer
            3) PPG Speedhide Zero Interior Latex Primer 6-4900XI
            4) SW Pro Mar 200 Zero VOC Primer B28
    5. Interior Rust-Inhibitive Water Based Primer; MPI #107.
        a. Products:

1) Benjamin Moore & Co.; Acrylic Metal Primer HPO4
2) Hallman Lindsay Paints; Tech Guard #338
3) PPG Pitt-Tech Primer 90-712
4) Rust-Oleum; 5281 DTM Acrylic Primer
5) SW Pro Industrial DTM Acrylic Primer/Finish B66

6. Interior/Exterior Quick Dry Alkyd Primer for Metal; MPI #76.
   a. Products:
      1) PPG Pitt-Tech Plus DTM Acrylic Primer, 4020 Series.
      2) Benjamin Moore & Co.; Universal Metal Primer P07
      3) Hallman Lindsay Paints; Metal Guard #330
      4) Sherwin-Williams Company (The); Ken Kromik Universal B50Z
7. Interior Water Based Primer for Galvanized Metal; MPI #134.
   a. Products:
      1) PPG Pitt-Tech Plus DTM Acrylic Primer, 4020 Series.
      2) Benjamin Moore & Co.; Acrylic Metal Primer HPO4
      3) Hallman Lindsay Paints; Tech Guard #338
      4) Rust-Oleum; 5281 DTM Acrylic Primer
      5) Sherwin-Williams Company (The); DTM Acrylic B66w1
8. Interior/Exterior Quick Dry Primer for Aluminum; MPI #95.
   a. Products:
      1) Benjamin Moore & Co.; Acrylic Metal Primer HPO4
      2) Hallman Lindsay Paints; Tech Guard #338
      3) PPG Multiprime 4160/4360
      4) Rust-Oleum; 5281 DTM Acrylic Primer
      5) SW Pro Industrial DTM Acrylic Primer/Finish B66
9. Latex Primer for Interior Wood; MPI #39.
   a. Products:
      1) Benjamin Moore & Co.; Fresh Start Acrylic Primer 023
      2) Hallman Lindsay Paints; Stain Guard #526
      3) PPG Seal Grip 17-921XI
      4) SW Pro Mar 200 Zero VOC Primer B28
10. Bonding Primer, Water Based; MPI #17.
    a. Products:
       1) Benjamin Moore & Co.; Fresh Start Acrylic Primer 023
       2) Hallman Lindsay Paints; Stain Guard #526
       3) PPG Seal Grip 17-921XI
       4) Rust-Oleum; Bulls-eye 1-2-3
       5) SW Pro Mar 200 Zero VOC Primer B28

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.

B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

C. Test shop-applied primer for compatibility with subsequent cover materials.

D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Gypsum Wallboard: 12 percent.
   2. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Seal surfaces that might cause bleed through or staining of topcoat.

E. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.

F. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

G. Galvanized Surfaces:

H. Ferrous Metal:
   1. Solvent clean according to SSPC-SP 1.
   2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
   3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.

I. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.

D. Sand wood and metal surfaces lightly between coats to achieve required finish.

E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.

F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

END OF SECTION

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SECTION 09 93 00
STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Surface preparation.

B. Field application of stains and transparent finishes.

1.02 SUBMITTALS

A. Product Data: Provide complete list of products to be used, with the following information for each:

B. Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on actual wood substrate to be finished, ____x____ inch in size.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.04 FIELD CONDITIONS

A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.

B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.

C. Do not apply materials when relative humidity exceeds 85 percent; at temperatures less than 5 degrees F above the dew point; or to damp or wet surfaces.

D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.

PART 2 PRODUCTS

2.01 STAINS AND TRANSPARENT FINISHES - GENERAL

A. Finishes:
   1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
   2. Supply each finish material in quantity required to complete entire project's work from a single production run.
   3. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
   1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

A. Clean surfaces thoroughly and correct defects prior to application.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.

D. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.03 APPLICATION

A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".

END OF SECTION

SECTION 09 96 00
HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. High performance coatings.

B. Surface preparation.

1.02 RELATED REQUIREMENTS

A. Section 09 90 00 - Painting and Coating: Requirements for mechanical and electrical equipment surfaces.

1.03 REFERENCE STANDARDS

A. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual Current Edition, www.paintinfo.com.

1.04 SUBMITTALS

A. Product Data: Provide data indicating coating materials .

B. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.

C. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

E. Maintenance Data: Include cleaning procedures and repair and patching techniques.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

C. Additional requirements for coating systems for existing exterior aluminum:
   1. Contractor is required to strictly adhere to the coating manufacturer’s recommended practices with regard to:
      a. Storage
      b. Mixing / Thinning
      c. Application
      d. Environmental Conditions / Concerns
   2. Contractor accepts all responsibility and liability for:
      a. Public safety / worker safety
      b. Hazardous & non-hazardous waste disposal
      c. Airborne paint and overspray concerns & claims
      d. All masking and protection of glass and non-coated substrate
      e. Any and all damage to glass and substrates
   3. Owner reserves the right to engage in independent 3rd party inspection for all work in progress. Inspection of the following areas should be considered appropriate:
   4. Surface preparation: determine that the degree of surface preparation specified is achieved. Surface profile to be measured using coarse Testex Tape/micrometer. No visible contamination has occurred since the surface prep operation, or since application of previous coat. There are no visible defects in previous coat.
   5. Coating storage: Determine that all coatings are stored within the manufacturer’s recommended storage temperatures. Establish that the coatings to be applied have not been damaged by age, improper storage, handling, etc. Establish that the coatings to be applied are the coatings specified.

6. Mixing and thinning: Document all product codes and batch numbers. Determine that the proper mixing ratios, components, induction times, and thinner amounts & product codes are correct.
7. Application: Document application equipment including tip sizes, pressures, and relevant information. Measure coating DFT thickness per SSPC PA-2, monitor and record applicator's WFT measurements if possible. Observe and document all pinholes, runs, sags, holidays, dry-spray, and visible defects in applied coating.
8. Environmental: Document ambient temperatures, relative humidity, surface temperature, and dew point prior to each application. Establish that each reading is within the manufacturer's specified range prior to application.
9. Documentation: Record keeping is not limited to the areas listed above.

1.06 MOCK-UP

A. Additional requirements for coating systems for existing exterior aluminum:
   1. *Due to the variability of substrate conditions, PPG Industries, Inc. recommends a mock-up application of the complete surface preparation / coating system to an area approximately 50 square feet to confirm satisfactory appearance and adhesion of the Coraflon ADS topcoat/primer system. This mock-up must be agreed upon by all parties to simulate finished product for architect / owner approval. A two month exposure period is recommended before evaluating the mock-up area for adhesion properties.*

1.07 FIELD CONDITIONS

A. Restrict traffic from area where coating is being applied or is curing.

1.08 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion.

B. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 TOP COAT MATERIALS

A. Manufacturer: Sherwin-Williams Company: www.protective.sherwin-williams.com/industries.
   1. Epoxy Coating for Gypsum Board Substrates: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
      a. Primers:
         1) Primer for Gypsum Board Substrates: S-W ProMar 200 Zero VOC Latex Primer, B282600 (4 mils wet, 1.5 mils dry.).
         2) As recommended by coating manufacturer for specific substrate, unless otherwise specified.
      b. Two coats, water-based epoxy, Eg-Shel finish.
         1) S-W Pro Industrial Zero VOC Water Based Epoxy Eg-Shel, B73-360 Series (2 to 4 mils dry per coat.)
         2) Color:
            (a) As indicated on Material Schedule on Drawings.
   2. Epoxy Coating for Steel Substrates: Provide the following finish systems over ferrous metal such as at hollow metal doors and frames at pharmacy cleanroom areas). Semigloss, Pre-Catalyzed Waterbased Epoxy Finish: 2 finish coats over a primer.
      a. Primer: Latex-based, interior primer applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 1.2 mils.
         1) SW: DTM Acrylic Primer/Finish (B66W1).
      b. First and Second Coats: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss applied at spreading rate recommended by the manufacturer to achieve a total dry film thickness of not less than 2.6 mils.
         1) SW: Pro Industrial Pre-Catalyzed Waterbased Epoxy Semi-Gloss, K46 series, <150 g/L VOC

c. Color:
1) As indicated on Material Schedule on Drawings.

2.02 COATING SYSTEM FOR EXISTING EXTERIOR ALUMINUM

A. System:
1. **Field Preparation:**
a. Existing caulk, sealant, and residue/contamination to be completely removed from substrate to be coated by means deemed appropriate by contractor. Do not coat over caulking. If caulking is not removed, and is painted up to caulking, coating subject to delamination along caulk edge.
b. Surface Preparation: Solvent Clean, per SSPC SP-1, or power-wash substrate to remove any contamination that may be present, including any silicone residue and chlorides.
c. Prepare via SSPC SP-16 / “Brush-Off Blast Non Ferrous Metal”, or power sanding similar to SSPC-SP-11 “Power Tool Commercial Cleaning” creating a 1-mil profile.
d. Prepare corroded any surfaces similar to SSPC SP-11, Power Tool Cleaning to Bare Metal, removing existing coatings, corrosion, while obtaining a surface profile of 1.5 to 2.0 mils. Feather sand edges. Prime areas the same day. May require multiple passes or coats to achieve recommended dft. All edges and bolts to be stripe coated.
e. Before each coating operation, surface will be clean, dry, contamination free.
2. **Primer: Coraflon ADS 573/574 Epoxy Intermediate Primer; 3.0-5.0 mils dft.**
a. Apply one coat of primer, using multiple passes spraying at 3.0 – 5.0 mils dft. May require multiple passes or coats to achieve recommended dft. All edges and bolts to be stripe coated. Refer to Technical Data Sheets for PPG products brush and roll application--may require 2 coats.
3. **Finish: Coraflon ADS; 1.8-2.2 mils dft.**
a. Apply one coat of color coat, using multiple passes spraying. May require multiple passes or coats to achieve recommended dft. All edges and bolts to be stripe coated.
b. Brush and roll application may require 2 coats solid colors only. Refer to Technical Data Sheets for PPG Products.
c. *Light Mica/Pearl Colors will require a barrier coat of ADS 564 at 1.5 to 2.0 mils. The ADS564 will be applied after the primer coat, before Coraflon Mica. Metallic colors will require a coat of Coraflon ADS Clear at 1.8 to 2.2 mils dft. Micas and Metallic colors are conventional spray application.*
d. Colors: Provide color matches indicated by reference to manufacturer’s color designations.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Do not begin application of coatings until substrates have been properly prepared.

C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.

D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.

3.02 PREPARATION

A. Clean surfaces of loose foreign matter.

B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.

C. Remove finish hardware, fixture covers, and accessories and store.

D. Protect adjacent surfaces and materials not receiving coating from spatter and overspray; mask if necessary to provide adequate protection. Repair damage.

3.03 PRIMING

A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in "MPI Architectural Painting and Specification Manual".

B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 CLEANING

A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

B. Clean surfaces immediately of overspray, splatter, and excess material.

C. After coating has cured, clean and replace finish hardware, fixtures, and fittings previously removed.

3.06 PROTECTION

A. Protect finished work from damage.

END OF SECTION

SECTION 10 11 00
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Markerboards
B. Tackboards
C. Tackstrips.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and supports.

1.03 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard 2009.
B. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board 2012.
C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Product Data: Provide manufacturer's data on tackboard and trim.
C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
D. Initial Samples: Submit color charts for selection of color and texture of markerboard and trim.
E. Test Reports: Show compliance to specified surface burning characteristics requirements.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

A. Markerboards: Porcelain enamel on steel, laminated to core.
   1. Color: White.
   2. Steel Face Sheet Thickness: 24 gage, 0.0239 inch .
   3. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
   4. Backing: Aluminum foil, laminated to core.
   5. Writing surface:
      a. Magnetic.
   6. Size: As indicated on drawings.
   7. Frame: Extruded aluminum , with concealed fasteners.
   8. Frame Finish: Anodized, natural.
   9. Accessories: Provide marker tray, map rail, and flag holder.
   10. Manufacturers:
      a. AJW Architectural Products; ____: www.ajw.com/#sle.
      b. Egan Visual Corporation; Egan Visual WhiteBoards: www.egan.com/#sle.
      c. ASI Visual Display Products; _____: www.asi-visualdisplayproducts.com/#sle.
B. Tackboards: Fine-grained, homogeneous natural cork.
   1. Cork Thickness: 1/4 inch.
   2. Backing: Fiberboard, 3/8 inch thick, laminated to tack surface.

3. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
4. Length: As indicated on drawings.
5. Frame: Extruded aluminum , with concealed fasteners.
6. Frame Profile: As indicated on drawings.
7. Frame Finish: Anodized, natural.
8. Manufacturers:
    a. AJW Architectural Products: www.ajw.com/#sle.
    b. Egan Visual Corporation: www.egan.com/#sle.
    c. ASI Visual Display Products: www.asi-visualdisplayproducts.com/#sle.
    d. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
    e. Substitutions: See Section 01 60 00 - Product Requirements.

C. Tackstrips: Fine-grained, homogeneous natural cork.
1. Cork Thickness: 1/8 inch.
2. Height: 1 inch.
3. Length: As indicated on drawings.
4. Frame and End Stops: Extruded aluminum, with concealed fasteners.
5. Frame Profile: As indicated on drawings.
6. Frame Finish: Anodized, natural.
7. Manufacturers:
    a. Nelson Adams NACO; ____: www.nelsonadamsnaco.com/#sle.

2.02 MATERIALS

A. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.

B. Fiber Board: ASTM C208, cellulosic fiber board.

C. Foil Backing: Aluminum foil sheet, 0.005 inch thick.

D. Adhesives: Type used by manufacturer.

2.03 ACCESSORIES

A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall , full width of frame.

B. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.

C. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.

D. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

3.03 INSTALLATION

A. Install boards in accordance with manufacturer's instructions.

B. Secure units level and plumb.

3.04 CLEANING

A. Clean board surfaces in accordance with manufacturer's instructions.

END OF SECTION

SECTION 10 14 23
PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Panel signage.

1.02 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements for submittal procedures.

B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.

C. Shop Drawings:
   1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
   2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
      a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
      b. When content of signs is indicated to be determined later, request such information from Owner through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
      c. Submit for approval by Owner through Architect prior to fabrication.

D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

1.03 FIELD CONDITIONS

A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.

B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Panel Signage:
   1. Best Sign Systems, Inc; ____: www.bestsigns.com/#sle.
   2. FASTSIGNS International, Inc; ____: www.fastsigns.com/#sle.
   3. Inpro Corporation; _____: www.inprocorp.com/#sle.
   4. Mohawk Sign Systems, Inc; ____: www.mohawksign.com/#sle.
   5. Seton Identification Products; ____: www.seton.com/aec/#sle.
   6. Takeform; ____: www.takeform.net/#sle.

2.02 PANEL SIGNAGE

A. Panel Signage Type _____:
   1. Application: Room and door signs.
   2. Description: Flat signs with engraved panel media, tactile characters.
   3. Total Thickness: 1/4 inch.
   4. Color and Font, unless otherwise indicated:
      a. Character Font: Room Numbers 1" Helvetica medium font.
      b. Character Case: Room Numbers Upper case only
      c. Background Color: As scheduled.
      d. Character Color: Letters shall be engraved white letters with black bacground, characters that contrast 70-100% with background.
   5. Material: Laminated colored plastic engraved through face to expose core as background color.
   6. Profile: Flat panel in aluminum frame.

a. Frame Finish: Black anodized.

7. Tactile Letters: Raised 1/32 inch minimum.

2.03 SIGNAGE APPLICATIONS

A. Room and Door Signs:

1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install with horizontal edges level.

C. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION

SECTION 10 21 13.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Phenolic toilet compartments.

B. Urinal screens.

1.02 REFERENCE STANDARDS

A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on panel construction, hardware, and accessories.

C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.

D. Samples: Submit two samples of partition panels, ____by____ inch in size illustrating panel finish, color, and sheen.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Phenolic Toilet Compartments:
   1. All American Metal Corp - AAMCO; _____: www.allamericanmetal.com/#sle.
   2. ASI Accurate Partitions; _____: www.asi-accuratepartitions.com/#sle.
   3. ASI Global Partitions; _____: www.asi-globalpartitions.com/#sle.

2.02 PHENOLIC TOILET COMPARTMENTS

A. Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-mounted headrail-braced.

B. Doors:
   1. Thickness: 3/4 inch.
   2. Width for Handicapped Use: 36 inch, out-swinging.
   3. Height: 58 inch.

C. Panels:
   1. Thickness: 3/4 inch.
   2. Height: 58 inch.

D. Pilasters:
   1. Thickness: 3/4 inch.
   2. Width: As required to fit space; minimum 3 inch.

E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets with vertical support/bracing same as compartments.

2.03 ACCESSORIES

A. Pilaster Shoes: Formed ASTM A666 Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.

B. Head Rails: Hollow anodized aluminum, 1 inch by 1-1/2 inch size, with anti-grip profile and cast socket wall brackets.

C. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.

D. Hardware: Polished stainless steel:
   1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.

2. Door Latch: Slide type with exterior emergency access feature.
3. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
4. Coat hook with rubber bumper; one per compartment, mounted on door.
5. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify correct spacing of and between plumbing fixtures.

C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.

B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.

C. Attach panel brackets securely to walls using anchor devices.

D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.

3.03 ADJUSTING

A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

B. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.

END OF SECTION

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Corner guards.

1.02 SUBMITTALS

A. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.

B. Shop Drawings: Include plans, elevation, sections, and attachment details. Show design and spacing of supports for protective corridor handrails, required to withstand structural loads.

C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.

1.04 WARRANTY

A. Provide five year manufacturer and installer warranty for metal crash rails.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Bumper Rails, Crash Rails, Protective Corridor Handrails, and Corner Guards:
   1. Babcock-Davis; _____: www.babcockdavis.com/#sle.
   2. Construction Specialties, Inc; Acrovyn Solid Color and Chameleon Crash Rails: www.c-sgroup.com/#sle.
   3. Inpro; _____: www.inprocorp.com/#sle.
   4. Koroseal Interior Products; _____: www.koroseal.com/#sle.
   5. Nystrom, Inc; _____: www.nystrom.com/#sle.

2.02 PRODUCT TYPES

A. Corner Guards - Flush Mounted:
   1. Material: High impact vinyl with full height extruded aluminum retainer.
   2. Material: Polyethylene terephthalate (PET or PETG); PVC-free with full height extruded aluminum retainer.
   3. Width of Wings: 2 inches.
   4. Corner: Square.
   5. Color: As selected from manufacturer's standard colors.
   6. Length: One piece.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

B. Verify that field measurements are as indicated on drawings.

C. Verify that substrate surfaces for adhered items are clean and smooth.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

B. Position corner guard 4 inches above finished floor to ____ inches high.

END OF SECTION

SECTION 10 26 01
WALL AND CORNER GUARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Bumper rails.

B. Corner guards.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

B. See Section 08 71 00 - Door Hardware, for hardware schedule indicating size of armor, kick, and mop plates to be provided by this Section 102601 - Wall and Corner Guards.

C. Section 08 75 10 - Solid Surface Wall Cladding: Where scheduled on Drawings as WP-4.

1.03 REFERENCE STANDARDS

A. ICC A117.1 - Accessible and Usable Buildings and Facilities 2017.

B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Indicate physical dimensions.

C. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.

1.05 QUALITY ASSURANCE

A. Surface Burning Characteristics: Provide assemblies with flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of impact-resistant wall-protection units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Wall and Door Protection:
   1. Inpro: www.inprocorp.com.
   2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 COMPONENTS

A. Bumper Rails: Factory- or shop-fabricated, with preformed end caps and internal and external corners:
   1. Material: Polyvinyl chloride; rigid, with Pebblette textured surface. Snap on cover of .080" thickness shall be extruded from chemical and stain resistant polyvinyl chloride with the addition of impact modifiers. No plasticizers shall be added (plasticizers may aid in bacterial growth).
   2. 4" height x 1" depth.
   3. Mounting: Surface.
   4. Fasteners: All mounting system accessories appropriate for substrates indicated on the drawings shall be provided. .
   5. Material: Metal; 6063-T3 Aluminum, clear anodized finish.
   6. Color: As scheduled.
   7. Mounting Height: See Drawings.

B. Corner Guards - Surface Mounted: High impact vinyl with Vinyl full height retainer and integral impact absorbing device. Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90-degree turn.
   1. Impact Strength: 30.2 ft-lbs/inch of thickness as tested in accordance with the procedures specified in ASTM D-256-90b, Impact Resistance of Plastics.
   2. Basis-of-Design Product: InPro 160 BluNose Series.
      a. Dimension: 2” x 2” x ¼” radius.
      b. Length: Full Height (install units starting at top of base.)
      c. Colors: As scheduled.
      d. Texture: Pebblette.
      e. Cover: 0.080” rigid plastic cover.
      f. Continuous Retainer: 0.070” thick, vinyl, fastened at maximum spacing of 18 inches O.C.
      g. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.03 FABRICATION

A. Fabricate components with tight joints, corners and seams.

B. Pre-drill holes for attachment.

C. Form end trim closure by capping and finishing smooth.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

3.02 INSTALLATION

A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.

B. Position corner guard just above wall base.

3.03 TOLERANCES

A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial toilet accessories.

B. Electric hand/hair dryers.

C. Diaper changing stations.

D. Utility room accessories.

E. Grab bars.

1.02 RELATED REQUIREMENTS

A. Section 08 83 00 - Mirrors: Other mirrors.

1.03 REFERENCE STANDARDS

A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.

B. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar 2015.

C. ASTM C1036 - Standard Specification for Flat Glass 2016.

D. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror 2018.

E. ASTM F2285 - Standard Consumer Safety Performance Specification for Diaper Changing Tables for Commercial Use 2004, with Editorial Revision (2016).

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the work with the placement of internal wall reinforcement and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Commercial Toilet, Shower, and Bath Accessories:
   1. Bradley Corporation: www.bradleycorp.com.
   2. Bobrick Corp..
   3. Substitutions: Section 01 63 11 - Product Substitutions.

B. Electric Hand/Hair Dryers:
   1. American Dryer, Extreme Air-EXT.

C. Diaper Changing Stations:
   1. Koala Kare Products; _____: www.koalabear.com/#sle.

D. Provide products of each category type by single manufacturer.

2.02 MATERIALS

A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.

2. Fabricate units made of metal sheet of seamless sheets, with flat surfaces.

B. Keys: Provide three keys for each accessory to Owner; master key lockable accessories.

C. Stainless Steel Sheet: ASTM A666, Type 304.

D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.

E. Adhesive: Two component epoxy type, waterproof.

F. Fasteners, Screws, and Bolts: Hot dip galvanized; tamper-proof; security type.

G. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.03 FINISHES

A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

2.05 COMMERCIAL TOILET ACCESSORIES

A. See schedule on drawings.

B. Basis of Design Product: Subject to compliance with requirements, provide products indicated on drawings as manufactured by Bobrick Washroom Equipment, Inc., or comparable products by one of the following:
1. Bradley Corporation

C. Electric Dryers: Traditional fan-in-case type, with downward nozzle.
1. Cover: White plastic.

D. Grab Bars: Stainless steel, smooth surface.

2.06 UTILITY ROOM ACCESSORIES

A. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify exact location of accessories for installation.

C. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.

D. Verify that field measurements are as indicated on product data.

3.02 PREPARATION

A. Deliver inserts and rough-in frames to site for timely installation.

B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.

B. Install plumb and level, securely and rigidly anchored to substrate.

C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.

D. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings

END OF SECTION

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SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Fire extinguishers.

B. Fire extinguisher cabinets.

C. Accessories.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Wood blocking product and execution requirements.

1.03 REFERENCE STANDARDS

A. FM (AG) - FM Approval Guide current edition.

B. NFPA 10 - Standard for Portable Fire Extinguishers 2013.

C. UL (DIR) - Online Certifications Directory current listings at database.ul.com.

1.04 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide extinguisher operational features.

C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.

D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.

E. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six years from date of Substantial Completion.

1.07 FIELD CONDITIONS

A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Fire Extinguishers:
   1. FE: [JL Industries]; Product [Cosmic 10E].
   2. Substitutions: See Section 01 60 00 - Product Requirements.

B. Fire Extinguisher Cabinets and Accessories:
   1. JL Industries, Inc: www.jlindustries.com.
      a. FEC-2:
         1) Type: Semi Recessed, suitable for fire extinguisher.
         2) Basis-of-Design Product: JL Industries, Ambassador, #1017-F-17-A.
         3) Trim Style: 3” return trim, rolled edge.
         4) Comply with ADA projection criteria.

2. Substitutions: See Section 01 63 11 - Product Substitutions.
    a. Larsen's Manufacturing Co: www.larsensmfg.com.
    b. Potter-Roemer: www.potterroemer.com.

2.02 FIRE EXTINGUISHERS

A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
    1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
    2. OSHA compliant.

B. Multipurpose Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gauge.
    1. Class: A:B:C type.
        a. Typical Application Fire Extinguisher: Multipurpose Dry-Chemical Type in Steel Container: UL-rated 4-A:80-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.
    2. Finish: Baked polyester powder coat, red color.
        a. Metal top (head) and valve
    3. Handles and Levers: Stainless steel.
        a. Provide hose and horn on each.
    4. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

2.03 FIRE EXTINGUISHER CABINETS

A. General:
    1. Metal: Formed primed steel sheet; 0.036 inch thick base metal.
    2. Provide a 1-hour fire rated, or a 2-hour fire rated cabinet as required by rating of wall type as designated on drawings at location of each cabinet.
    3. Door style with full glass, double strength.
    4. Door Hardware:
        a. Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
        b. ADA Compliant recessed pull.
        c. Provide manufacturer's standard hinge permitting door to open 180 degrees.

B. Cabinet Configuration: Recessed type (FEC-1).
    1. Sized to accommodate accessories.
    2. Trim: Returned to wall surface, with 3 inch projection.
    3. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim .
    4. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
    5. Door Glazing: Glass, clear, 1/8 inch thick float. Set in resilient channel gasket glazing.
    6. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
    7. Weld, fill, and grind components smooth.
    8. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.
    9. Finish of Cabinet Interior: White enamel.

C. Cabinet Configuration: Semi-recessed type (FEC-2).
    1. Exterior nominal dimensions of ____ inch wide x ____ inch high x ____ inch deep.
    2. Form cabinet enclosure with right angle inside corners and seams. Form perimeter trim and door stiles.
    3. Door: 0.036 inch thick, reinforced for flatness and rigidity; latch. Hinge doors for 180 degree opening with two butt hinge. Provide nylon catch.
    4. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
    5. Weld, fill, and grind components smooth.
    6. Finish of Cabinet Exterior Trim and Door: Baked enamel, white color.
    7. Finish of Cabinet Interior: White enamel.

2.04 ACCESSORIES

A. Extinguisher Brackets: Formed steel, galvanized and enamel finished.
   1. Color: Red with Chrome Strap (Basis of Design: JL Industries, #MB846C)

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.
   1. Provide building standard, wall mounted plastic sign:
      a. Basis of Design.
         1) Manufacturer JL Industries.
         2) Product Number: FE #24S
         3) Configuration: 3D Tent
         4) Size: 5-inches x 6-inches.
         5) “Bottom of sign to be mounted at 84” a.f.f.”

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions before starting work.

B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure rigidly in place.

C. Place extinguishers in cabinets.

END OF SECTION

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SECTION 11 68 13
PLAYGROUND EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Playground Equipment

B. Engineered Wood Fiber

C. Play Pit Drainage

1.02 SUBMITTALS

A. Product data: Submit manufacturer's technical data and installation instructions for each item of equipment required and for the engineered wood fiber (EWF) and associated drainage system. Provide statement of accessibility from manufacturer, including total number of play components as well as total number of accessible components. Provide both plan view and 3-dimensional views of equipment. Provide manufacturer's product literature and specifications data for poured-in-place surfacing.

1.03 REFERENCES

A. Safety:
1. American Society for Testing and Materials (ASTM) designation F1487 98 (or current issue) "Standard Consumer Safety Performance Specification for Playground Equipment for Public Use."
   a. U.S. Consumer Product Safety Commission (CPSC) Handbook for Public Playground Safety (Publication No. 325) (based on ASTM F 1487).
   b. CPSC Playground Surfacing Materials (Publication No. 325).
   c. CPSC Guidelines for Movable Soccer Goal Safety (Publication No.326).
   d. Reference Standards and design guidelines: 2009 ICC A1117.1, 105.2.8 & 105.2.9. Accessible and Usable Buildings and Facilities – Chapter 11 recreation facilities -1108 Play Areas.

1.04 QUALITY ASSURANCE

A. Engineered Wood Fiber Certifications:
1. EWF and wear mats shall meet impact attenuation requirements of ASTM F1292-18e1 – Standard Specification for Impact Attenuation of Surface Systems Under and Around Playground Equipment and ASTM F1292-18e1-Standard Specification for Impact Attenuation of Surfacing Materials within Use Zone of Playground Equipment.
   a. For EWF:
      (i) G-max values less than 120G for 12" system at a 12' drop height.
      (ii) HIC value less than 1,000 for both new and 12-year old material.
   b. For wear mats:
      (i) G-max values less than 200G from 4" drop height.
      (ii) HIC value less than 1,000 at 4" drop height.
2. Meet requirements of ASTM F 1951, Standard Specification for Determination of Accessibility of Surface Systems Under and Around Playground Equipment.
3. Meet accessibility requirements of Access Board, Final Report.
4. Contractor must submit a copy of chosen EWF manufacturer's guidelines on installation for accessible pathways to the project's State Inspector at the end of the project.
5. Contractor to prepare a signed letter, from the Company Owner or Chief Officer on Company letterhead. The letter must be signed and must certify that the material has been compacted and installed as specified by the EWF manufacturer to meet accessibility requirements. The letter must be received (send to Project's State Inspector) at or before the final project inspection.
6. Contractor must provide a signed letter or email on company letterhead certifying that the piers for the playground equipment were constructed and installed per approved manufacturer's installation specifications.

7. Owner shall provide a signed maintenance plan for the EWF, outlining the scope and schedule of maintenance.

B. Place no EWF until all structures have been placed.

PART 2 PRODUCTS

2.01 MATERIALS

A. All requests for substitutions must be submitted in writing with supporting documentation by or through the Contractor to the Landscape Architect for initial review, before being submitted to the Owner for evaluation and final approval. Subject to compliance with requirements, the equipment may be provided by the following vendor's:

B. ECE Playground:

1. Play Equipment:
    a. Main Composite – Gametime 2-5 Composite with Umbra Roof. Color TBD.Contact Doug Johannsen at doug@altituderec.com or Angela Boese at angela@altituderec.com.
    b. Swings: Gametime Single-Bay 8' Single Post Swing with Belt Seat Package (2), Enclosed Tot Seat Package (1) and ADA Zero G Seat Package (1).
    c. Climbing Events: Gametime Discover Cave w/Rock Grips (1), Curved Balance Beam (1), 2' Hex Pods (1) and 1' Hex Pods (4).
    d. Independent Play Piece: Gametime Bongos, Ashiko and Tic-Tac-Toe Panel. Qty. (1 ea).
2. Sand Pit Cover: For 16'x10' sand box. Provide custom cover capable of being secured to sand box lip. PVC coated polyester. Provide D-rings at 24" for attachment with 8" side extension. Verify final dimensions prior to ordering. Contact Covers & All at coversandall.com, or approved equal.

C. Wear mats: 3' x 5' x 2" beveled edge rubber mat by Action Play Systems, or equal.

2.02 DRAIN PIPE

A. Drain pipe shall be Polyvinylchloride (PVC) pipe, bell end, perforated to meet ASTM 2729.

2.03 PLAYGROUND SURFACING

A. EWF:
1. Meet certification requirements noted above.

B. Geotextile Fabric:

1. Minimum 3.5 OZ/SY.
2. Non-oven synthetic.

C. Drainage Rock:
1. 3" depth, #67 blend clean, angular drainage stone.

PART 3 EXECUTION

3.01 INSTALLER

A. Playground equipment shall be installed only by person trained and certified by the manufacturer.

3.02 INSPECTION

A. Verify gradients and elevations of base. Verify compaction for all footings and subgrades. Beginning of installation means acceptance of existing conditions.

3.03 PREPARATION

A. Before geotextile fabric has been installed, locate each item of equipment accurately as indicated. Obtain field verification of location for each item from Owner's Representative before proceeding.

3.04 GENERAL

A. Fine grading: Fine grade all areas to receive EWF material. Remove all sticks, stones or clods over 1” in diameter and grade soil smoothly and evenly.

B. Drainage system and Geotextile Fabric: Place geotextile fabric, overlap all seams by 12” minimum. Sew or glue any overlapping seams together so monolithic surface is created. Attach fabric securely as shown on plans. Install drainage system as shown on plans.

C. Engineered Wood Fiber: Fill fabric with 12” minimum compacted depth material. Grade smoothly. EWF material shall be installed correctly in lifts according to the manufacturer’s guidelines on installation for accessible pathways. EWF must meet all compaction, attenuation requirements, performance requirements and all factors to determine accessibility with the use of a playground.

D. Drainage Rock: Place to a minimum 3” depth under EWF.

E. Wear Mats: Provide in high traffic zones, including beneath swing seats, at slide exits, beneath slide poles and at all ramp entry points. Install at mid-depth of EWF.

3.05 FIELD QUALITY CONTROL

A. All items must be protected from staining, cracking, chipping, vandalism, and other drainage during progress of the work and left in a first-class condition upon completion.

END OF SECTION

SECTION 12 21 13
HORIZONTAL LOUVER BLINDS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Horizontal slat louver blinds.

B. Operating hardware.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.

1.03 REFERENCE STANDARDS

A. WCMA A100.1 - Safety of Corded Window Covering Products Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordinate the placement of concealed blocking to support blinds. See Section 06 10 00.

1.05 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data indicating physical and dimensional characteristics.

C. Shop Drawings: Indicate opening sizes, tolerances required, method of attachment, clearances, and operation. Indicate side of handle and cord.

D. Samples: Submit two samples, 6 inch long illustrating slat materials and finish, cord type and color.

E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 BLINDS

A. Description: Horizontal slat louvers hung from full-width headrail with full-width bottom rail.

B. Manual Operation: Control of raising and lowering by cord with full range locking; blade angle adjustable by control wand.

C. Blinds: Horizontal slat louvers hung from full-width headrail with full-width bottom rail; manual control of raising and lowering by cord with full range locking; blade angle adjustable by control wand; complying with WCMA A100.1.

D. Metal Slats: Spring tempered pre-finished aluminum; radiused slat corners, with manufacturing burrs removed.
   1. Width: 1 inch.
   2. Thickness: 0.008 inch.
   3. Color: As selected by Architect.

E. Slat Support: Woven polypropylene cord, ladder configuration.

F. Head Rail: Pre-finished, formed aluminum box, with end caps; internally fitted with hardware, pulleys, and bearings for operation; same depth as width of slats.
   1. Color: Same as slats.

G. Bottom Rail: Pre-finished, formed steel with top side shaped to match slat curvature; with end caps. Color: Same as headrail.

H. Control Wand: Extruded hollow plastic; hexagonal shape.
   1. Non-removable type.
   2. Length of window opening height less 3 inch.

3. Color: Clear.

I. Headrail Attachment: Wall brackets.

2.02 FABRICATION

A. Determine sizes by field measurement.

B. Fabricate blinds to fit within openings with uniform edge clearance of 1/4 inch.

C. At openings requiring multiple blind units, provide separate blind assemblies with space of 1/4 inch between blinds, located at window mullion centers.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that openings are ready to receive the work.

3.02 INSTALLATION

A. Install blinds in accordance with manufacturer's instructions.

B. Secure in place with flush countersunk fasteners.

3.03 TOLERANCES

A. Maximum Variation of Gap at Window Opening Perimeter: 1/4 inch.

B. Maximum Offset From Level: 1/8 inch.

3.04 ADJUSTING

A. Adjust blinds for smooth operation.

3.05 CLEANING

A. Clean blind surfaces just prior to occupancy.

END OF SECTION

SECTION 12 32 00
MANUFACTURED WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured standard and custom casework, with cabinet hardware.

B. Countertops.

1.02 RELATED REQUIREMENTS

A. Section 06 10 00 - Rough Carpentry: Blocking and nailers for anchoring casework.

B. Section 07 92 00 - Joint Sealants: Sealing joints between casework and countertops and adjacent walls, floors, and ceilings.

C. Section 12 36 00 - Countertops: Additional requirements for countertops.

D. Section 22 40 00 - Plumbing Fixtures: Sinks and fittings installed in casework.

1.03 REFERENCE STANDARDS

A. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings, Safety Performance Specifications and Methods of Test 2010.

B. ASTM C1036 - Standard Specification for Flat Glass 2016.

C. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.

D. BHMA A156.9 - American National Standard for Cabinet Hardware 2010.

E. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.04 SUBMITTALS

A. Product Data: Component dimensions, configurations, construction details, joint details, attachments.

B. Shop Drawings: Indicate casework types, sizes, and locations, using large scale plans, elevations, and cross sections. Include rough-in and anchors and reinforcements, placement dimensions and tolerances, clearances required, and keying information.

C. Samples for Finish Selection: Fully finished, for color selection. Minimum sample size: 2 inches by 3 inches.

D. Maintenance Data: Manufacturer's recommendations for care and cleaning.

E. Finish touch-up kit for each type and color of materials provided.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience and approved by manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect items provided by this section, including finished surfaces and hardware items during handling and installation. For metal surfaces, use polyethylene film or other protective material standard with the manufacturer.

B. Acceptance at Site:
   1. Do not deliver or install casework until the conditions specified under Part 3, Examination Article of this section have been met. Products delivered to sites that are not enclosed and/or improperly conditioned will not be accepted if warping or damage due to unsatisfactory conditions occurs.

C. Storage:
   1. Store casework in the area of installation. If necessary, prior to installation, temporarily store in another area, meeting the environmental requirements specified under Part 3, "Site Verification

of Conditions" Article of this section.

1.07 WARRANTY

A. Correct defective Work within a five year period after Date of Substantial Completion, at no additional cost to Owner. Defects include, but are not limited to:
   1. Ruptured, cracked, or stained finish coating.
   2. Discoloration or lack of finish integrity.
   3. Cracking or peeling of finish.
   4. Failure of hardware.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Plastic Laminate Casework:
   1. Case Systems; ____: www.casesystems.com/#sle.
   2. Diversified Fixture; ____: www.diversifiedfixture.com/#sle.
   3. Labscape LLC; ____: www.labscape.com/#sle.

2.02 CASEWORK, GENERAL

A. Quality Standard: AWI/AWMAC/WI (AWS), unless noted otherwise.

B. Types: More than one type is required. See drawings for location of each type of casework.

C. Plastic Laminate Faced Cabinets: Custom Grade.

2.03 FABRICATION

A. Assembly: Shop assemble casework items for delivery to site in units easily handled and to permit passage through building openings.

B. Construction: As required for selected grade.

C. Glazing for Doors: Clear tempered glass.

D. Fittings and Fixture Locations: Cut and drill components for fittings and fixtures.

E. Removable back panels on all base cabinets. Provide partial height back panels at sink cabinets.

F. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.

G. Apron Frames: Construction similar to other cabinets, with modifications.

H. Countertop Panel-Type Supports: Materials similar to adjacent casework, 1-1/2 inch in width, with front-to-back and toe space dimensions matching base cabinet. Designed to be secured in a concealed fashion to countertop material. Include two leveling devices per support panel.

2.04 PLASTIC-LAMINATE-CLAD CASEWORK

A. Plastic-Laminate-Clad Casework: Solid wood and wood panel construction; each unit self-contained and not dependent on adjacent units or building structure for rigidity; in sizes necessary to avoid field cutting except for scribes and filler panels. Include adjustable levelers for base cabinets.
   1. Style: Flush overlay. Ease doors and drawer fronts slightly at edges.
   2. Cabinet Nominal Dimensions: Unless otherwise indicated, provide cabinets of widths and heights indicated on drawings, and with following front-to-back dimensions:
      a. Base Cabinets: 22 inches.
      b. Tall Cabinets: 22 inches.
      c. Wall Cabinets: 16 inches.
   3. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline.
      a. Finish: Matte or suede, gloss rating of 5 to 20.
      b. Surface Color and Pattern: As indicated on drawings.
      c. Exposed Interior Surfaces: Thermally fused laminate.
         1) Color: White.

2.05 COUNTERTOPS

A. Countertops: As specified in Section 12 36 00.

2.06 CABINET HARDWARE

A. Manufacturer's standard types, styles and finishes.

B. Comply with BHMA A156.9 requirements.

C. Locks: Provide locks on casework drawers and doors where indicated. Lock with 5 pin cylinder and 2 keys per lock.

D. Shelves in Cabinets:
   1. Shelf Standards and Rests: Vertical standards with rubber button fitted rests, satin chromium plated over nickel on base material.

E. Swinging Doors: Hinges, pulls, and catches.
   1. Hinges: Visible, number as required by referenced standards for width, height, and weight of door.
      a. Visible Hinges: Installed on framed cabinet face, and on door face, bright chromium plated over nickel on base material.
   2. Pulls: Recessed ABS.
   3. Catches: Magnetic.

F. Drawers: Pulls and slides.
   1. Pulls: Chrome wire pulls, 4 inches wide.
   2. Slides: Steel, full extension arms, ball bearings; self-closing; capacity as recommended by manufacturer for drawer height and width.

2.07 MATERIALS

A. Adhesives Used for Assembly: Comply with VOC requirements for adhesives and sealants as specified in Section 01 61 16.

B. Wood-Based Materials:
   1. Solid Wood: Air-dried to 4.5 percent moisture content, then tempered to 6 percent moisture content before use.

C. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications. complying with Grade requirements, and standard with the manufacturer.

D. Thermally Fused Laminate (TFL): Melamine resin, NEMA LD 3, Type VGL laminate panels.

E. Glass: Fully tempered float; ASTM C1036, Type 1, Quality Q3; ASTM C1048, tempered using horizontal tempering and complying with ANSI Z97.1; 3/16 inch thick minimum; exposed edges ground, and cut or drilled to receive hardware; clear.

2.08 ACCESSORIES

A. Plastic Edge Banding: Extruded PVC, convex shaped; smooth finish; self locking serrated tongue; of width to match component thickness.
   1. Color: As selected by Architect from manufacturer's standard range.
   2. Color: As shown on drawings.
   3. Use at exposed edges.

B. Grommets: Standard plastic, painted metal, or rubber grommets for cut-outs, in color to match adjacent surface.

PART 3 EXECUTION

3.01 PREPARATION

3.02 EXAMINATION

A. Site Verification of Environmental Conditions:
   1. Do not deliver casework until the following conditions have been met:
      a. Building has been enclosed (windows and doors sealed and weather-tight).

b. An operational HVAC system that maintains temperature and humidity at occupancy levels has been put in place.
c. Ceiling, overhead ductwork, piping, and lighting have been installed.
d. Installation areas do not require further “wet work” construction.

B. Verify adequacy of support framing and anchors.

C. Verify that service connections are correctly located and of proper characteristics.

3.03 INSTALLATION

A. Perform installation in accordance with manufacturer's instructions.

B. Use anchoring devices to suit conditions and substrate materials encountered. Use concealed fasteners to the greatest degree possible. Use exposed fasteners only where allowed by approved shop drawings, or where concealed fasteners are impracticable.

C. Set casework items plumb and square, securely anchored to building structure.

D. Align cabinets to adjoining components, install filler and/or scribe panels where necessary to close gaps.

E. Fasten together cabinets in continuous runs, with joints flush, uniform and tight. Misalignment of adjacent units not to exceed 1/16 inch. In addition, do not exceed the following tolerances:
1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
2. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
3. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
4. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.

F. Base Cabinets: Fasten cabinets to service space framing and/or wall substrates, with fasteners spaced not more than 16 inches on center. Bolt adjacent cabinets together with joints flush, tight, and uniform.

G. Install hardware uniformly and precisely.

H. Countertops: Install countertops intended and furnished for field installation in one true plane, with ends abutting at hairline joints, and no raised edges.

I. Replace units that are damaged, including those that have damaged finishes.

END OF SECTION

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Countertops.

B. Wall-hung counters and vanity tops.

C. Window stools (interior sills).

1.02 REFERENCE STANDARDS

A. ANSI A208.1 - American National Standard for Particleboard 2009.

B. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use 2009.

C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021.

D. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards 2014.

E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.0 2016.

F. IAPMO Z124 - Plastic Plumbing Fixtures; 2017.

G. ISFA 2-01 - Classification and Standards for Solid Surfacing Material 2013.

H. NEMA LD 3 - High-Pressure Decorative Laminates 2005.

1.03 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Specimen warranty.

C. Shop Drawings: Complete details of materials and installation .

D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.

F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.

G. Installation Instructions: Manufacturer's installation instructions and recommendations.

H. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.04 QUALITY ASSURANCE

A. Fabricator Qualifications: Same fabricator as for cabinets on which tops are to be installed.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.06 FIELD CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

PART 2 PRODUCTS

2.01 COUNTERTOPS

A. Quality Standard: Custom Grade, in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), unless noted otherwise.

B. Provide 1-1/2-inch radius (looking down, plan view) at all outside corners in countertops.

C. Solid Surfacing Countertops:
   1. Thickness: 3cm.
   2. Solid Surfacing: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
      a. Manufacturers:
         1) Avonite Surfaces; _____: www.avonitesurfaces.com/#sle.
         2) Dupont; _____: www.corian.com/#sle.
         3) Formica Corporation; _____: www.formica.com/#sle.
         4) Wilsonart; _____: www.wilsonart.com/#sle.
      b. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
      c. Color and Pattern: As indicated on drawings.
   3. Other Components Thickness: 1/2 inch, minimum.
   4. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
   5. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

A. Wood-Based Components:
   1. Wood fabricated from old growth timber is not permitted.
   2. Provide sustainably harvested wood, certified or labeled as specified in Section 01 60 00 - Product Requirements.
   3. Provide wood harvested within a 500 mile radius of the project site.

B. Particleboard for Supporting Substrate: ANSI A208.1, Grade M-3, with waterproof adhesive, 3/4 inch thick; join lengths using metal splines.

C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
   1. Core material for plastic laminate window sills:
      a. Medium Density Fiberboard (MDF).
         1) Meet or exceed ANSI 1037-87.
         2) Exterior density, formaldehyde free.
         3) Base: Medite Corporation: “MEDEX”; Medford, OR. (1 800/676-3339).

D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

E. Joint Sealant: Mildew-resistant silicone sealant, white.

2.03 ACCESSORIES

A. Exposed Metal Cantilever Support Brackets:
   1. Manufacturer: A & M Hardware, Inc.
   2. Thickness: 1/8-inch thick steel.
   3. Capacity: 1,000 lbs, each.
   4. Finish:
      a. Stainless steel: For support of stainless steel countertops, only.
      b. All other applications: Color to be selected by Architect from Manufacturer's full range of standard colors.
   5. Sizes: Appropriate for countertop depth.

B. Concealed Metal Support Brackets: Where concealed metal support brackets are indicated on drawings for support of shelves and countertops, etc, provide steel support brackets in an L-

configuration with length of legs as required for size application. Profile and gage of steel shall be sufficient to support fully loaded shelf with a safety factor of three.

1. Rakks - Flush Mount
    a. Nearly invisible support with 2" x 2" x 1/4" L-shaped vertical leg that is screwed to the side of the stud. After installation of the bracket, drywall is mounted to the studs, hiding the vertical support leg.
    b. Powder coated finish in color selected by Architect.

2.04 FABRICATION

A. Fabricate tops in the largest sections practicable, with top surface of joints flush.
    1. Join lengths of tops using best method recommended by manufacturer.
    2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
    3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.

B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
    1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
    2. Height: 4 inches, unless otherwise indicated.

C. Countertop joints:
    1. Joints are prohibited within 24” of sinks.
    2. Joints in counter length shall be factory fitted, splined, glued, and mechanically fastened.
    3. Provide joint connectors every 6” o.c. at countertop joints.

D. Fasteners:
    1. Use no blocking or fasteners in exposed or semi-exposed locations.
    2. Pre-drill and countersink screw holes before installation.
    3. Do not use mechanical fasteners or blocking in exposed locations.

E. Stainless Steel: Fabricate tops up to 144 inches long in one piece including nosings and back and end splashes; accurately fitted mechanical field joints in lengths over that dimension are permitted.
    1. Weld joints; grind smooth and polish to match.
    2. Provide stainless steel hat channel stiffeners, welded or soldered to underside, where indicated on drawings.
    3. Provide wall clips for support of back/end splash turndowns.
    4. Sound Deadening: Apply water resistant, fire resistant sound deadening mastic to entire bottom surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.

3.02 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.

B. Seal joint between back/end splashes and vertical surfaces.

3.04 CLEANING

A. Clean countertops surfaces thoroughly.

3.05 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 93 00
SITE FURNISHINGS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Section Includes:
1. Bench
2. 15'x15' Shelter
3. Round Picnic Tables
4. Rectangular Picnic Tables
5. Trash Receptacles
6. ~~Player's Bench~~
7. Storage Building

1.02 SUBMITTALS

A. Submit manufacturer's technical data. Provide material and color sample prior to placement. Provide soil compaction tests as required in the general conditions.

1.03 QUALITY ASSURANCE

A. Coordination: All metal edging to be placed after final grades are established.

B. Perform work with personnel experienced in the work required under direction of a skilled foreman.

1.04 EXISTING CONDITIONS

A. Contractor shall approve existing conditions prior to beginning all landscape work. Beginning work indicates acceptance of existing conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. 6' Bench:
1. 6' Bench: Anova Ari Leaf 6' Contour Bench, #AE2680LF. Surface Mount. Color TBD. Qty. (3). Contact Katie Bridges, katie.b@anovafurnishings.com.

B. 15'x15' Shelter:
1. 15'x15' Shelter: Cedar Forest Products Shelter: RHS 15'x15'x8'H. Roof pitch is 4:12, powder coated steel frame w/24ga. Multi-rib roofing with Krynar 500 finish with white underside. Tubular steel frame with hidden bolts and fasteners. Contractor to include stamped engineering drawings. Color TBD. Contact Doug Johannsen at Altitude Recreation doug@altituderec.com, or Angela Boese angela@altituderec.com. Qty. (1).

C. 42" Round Picnic Table-4 Seat:
1. Round Picnic Table: Anova Ultra Expanded Steel ADA Table, 3-Seats, #F2016. Color TBD. Qty. (1).
2. Round Picnic Table: Anova Ultra Expanded Steel Table, 4-seats, #F2015. Color TBD. Qty. (1).

D. 42" Round Picnic Table-3 Seat:
1. Round Picnic Table: TBD

E. Rectangular Picnic Table:
1. 8' Rectangular Picnic Table: Anova 8' Rectangular Expanded Steel ADA table, Color TBD. Qty. (2).

F. Trash Receptacles:
1. Trash Receptacles: Anova 32-Gallon Trash Receptacle with Bonnet Top and Liner, #L1378BT. Color TBD. Qty. (1).

~~G. Player's Bench:~~

~~1. 8' Player's Bench: Anova Victory 8' Perforated Steel Flat Bench, #D3025. Traditional Edge, Surface Mount. Color TBD. Qty. (4).~~

I. Storage Shed:

1. Tuff Shed or equal, 8'x10'. Premier Lean-To with (2) gable vents, double door on high side of roof, dimensional shingles and shed anchors into concrete. Colors TBD. Qty. (1).

PART 3 EXECUTION

3.01 PREPARATION

A. Excavate for footings. Moisten base, compact to 90% of Standard Proctor Density.

3.02 INSTALLATION

A. Benches: Install per manufacturer's specifications.

B. Shelter: Install per manufacturer's specifications.

C. Picnic Tables: Install per manufacturer's specifications.

D. Trash Receptacles: Install per manufacturer's specifications.

E. ***Storage Building: Install per manufacturer's specifications.***

3.03 FIELD QUALITY CONTROL

A. All items must be protected from staining, cracking, chipping, vandalism, and other drainage during progress of the work and left in a first-class condition upon completion.

END OF SECTION

SECTION 210100
BASIC FIRE SUPPRESSION REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL CONDITIONS

A. The General Conditions of the Contract and Supplementary Conditions of the General Contract apply to work under this Division.

1.02 QUALITY ASSURANCE

A. The fire suppression design for this project is based on specific manufacturers and equipment as scheduled on the drawings and listed in these Division specifications with specific model number identifiers. Acceptable substitute manufacturers of equipment are listed in these specifications. If any acceptable substitute manufacturer's equipment is used, the cost of any change in design or construction required by their use shall be borne by the contractor. Contractor shall document and submit all changes to design plans and schedules as a result of the use of substituted equipment.

B. If manufacturer's material or equipment is listed in Schedules or on Drawings, they are types to be provided for establishment of size, capacity, grade, and quality. If other acceptable manufacturers are used, cost of any change in construction required by their use shall be borne by Contractor.

C. Equipment shall conform to State and/or local Energy Conservation Standards.

D. Execute and test all work per Underwriters, state and local codes, rules, and regulations applicable to trade affected. Included are recommendations of NFPA and OSHA. References to standards are latest revision of standard specified.

E. Comply with rules and regulations of jurisdictional fire authorities and local utility companies.

1.03 INTENT AND INTERPRETATIONS

A. It is the intent of these Drawings and Specifications to result in a complete fire suppression system installation in complete accordance with all applicable codes and ordinances.

B. Drawings are diagrammatic in character and do not necessarily indicate every required pipe, offset, transition, etc. Items not specifically mentioned in the Specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.

C. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. The more stringent requirements shall govern.

D. Where Drawings and specifications call for installation in excess of NFPA requirements, fire sprinkler system shall be designed based on the specified requirements.

E. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, take the necessary measurements and prepare the drawings.

F. Symbols used on the Drawings are defined in the Legend on the Drawings. All symbols indicated on the Legend may not necessarily be required for the project.

G. “Provide” shall mean “furnish and install.” “Accepted” or “acceptable” denotes the work or equipment item is in conformance with the design concept of the project and, in general, complies with the pertinent information given in the Contract Documents.

H. Prior to ordering equipment, determine that equipment will adequately pass through building openings and passageways providing unobstructed access to final equipment location. Equipment shall be manufactured and shipped in sections for assembly in final equipment location when

inadequate building openings and passageways limit access. Shop drawings and submittals shall indicate sectionalized manufacturing of equipment.

I. Before any work is installed, determine equipment will properly fit the space, required clearances can be maintained and equipment can be located without interferences between systems, with structural elements, or with the work of other trades.

J. If conflicts are discovered in Contract Documents as work progresses, submit a set of drawings marked with red pencil showing recommended modifications to the Architect for approval prior to installation.

K. The Drawings indicate the general arrangement of systems and components. However, rearrangement will not be permitted without specific approval prior to installation.

L. Provide incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like whether listed or not.

M. Provide labor, fees, licenses, start-up and checkout services.

N. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Architect in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply all necessary materials and labor required for the proper completion of this work.

1.04 JOB CONDITIONS

A. Location, size, and type of equipment and material shown as existing are taken from existing drawings. Verify exact conditions in field prior to start of construction.

B. Owner supplied existing equipment will be installed. Become familiar with existing rough-in requirements prior to installation. Report any difficulties or discrepancies to Architect prior to start of work.

C. Not all piping and offsets, transitions, and multiple connections required to install the new work into the available space are shown on the drawings. Field measure for exact requirements and install accordingly.

D. Confer, cooperate, and coordinate work with other trades. Coordinate ceiling cavity space carefully with all trades. In event of conflict, install systems within cavity space in following order of priority.
   1. Plumbing waste and vent piping.
   2. Roof drain piping.
   3. Ductwork.
   4. Electrical conduit and lighting.
   5. Domestic hot and cold water piping.
   6. Hydronic piping
   7. Fire sprinkler piping.

E. Where locations of devices and equipment are not specifically mentioned in the Specifications or indicated on the Drawings, verify locations with Architect or Owner prior to rough-in.

F. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.

1.05 PERMITS AND FEES

A. Arrange and pay for all inspections, permits, licenses, certificates, and fees required in connection with work.

1.06 SUBMITTALS AND SHOP DRAWINGS

A. All electronic submittal data shall be provided in separate Portable Document Format (pdf) folders for each individual Division specification section.

B. All shop drawings and submittal data shall bear a unique submittal number. Submittal number shall consist of three sets of numeric values. Submittal number shall be in the XXXX-XXX-XX format with the first set of numbers representing the specification section, the second set of numbers representing the submittal number for that particular specification section, and the final two numbers representing the submittal number for that particular item. Original submittals shall bear 01 as the final set of numbers, and re-submittals shall begin with 02 and follow with each re-submittal.

C. Submittals not conforming with the formats outlined above will be returned at the contractors expense for re-submittal conforming with the above.

D. Submittals shall include catalog cut-sheets, manufacturer's data sheets, written descriptions, and specification sheets detailing the associated product, item, and assembly. Reference other Division Sections for additional information and requirements specific to those sections.
   1. Resubmittals shall include information required above, along with reference to original submittal section tab being corrected.

E. Shop drawings shall include details, installation drawings, assembly drawings, fabrication drawings, diagrams, and other information which show adaptation or installation of Contractor-furnished products or materials for overall project.

F. Prior to ordering equipment or beginning installation work, assemble, prepare, and furnish submittals and shop drawings required for project. Furnish submittals and shop drawings as required by individual sections of specifications.

G. Contractor shall thoroughly check subcontractors' or vendors' submittals and shop drawings and, after approving them, submit them for review. Submittals and shop drawings that do not bear Contractor's review stamp or that do not comply with all of the above requirements will be returned “Not Reviewed.”

H. The purpose of submittals and shop drawings is to ensure Contractor understands design requirements and demonstrates understanding by indicating and detailing intended materials, methods, and installation practices. Submittals and shop drawings are not a method of requesting substitutions or deviation from Specifications. If discrepancies between submittals, shop drawings, and Contract Documents are discovered either prior to or after submittals and shop drawings are reviewed, requirements of Contract Documents shall take precedence. Submittals and shop drawings which are submitted, but which are not required by Contract Documents, will be returned Not Reviewed.

I. Review of submittals and shop drawings and action recommended as result of review is courtesy extended to Contractor by Owner's representative. This review is intended to minimize delivery to job site and installation of materials and equipment that do not meet intent of Construction Documents. Submission of material for review does not alter Contractor's obligation to follow intent of Construction Documents, nor Contractor's responsibility to comply therewith.

J. Submittals and shop drawings shall identify specific equipment with numbers or letters identical to those listed or scheduled on the Drawings or Specifications.

1.07 SUBSTITUTIONS

A. Equipment scheduled on drawings and specifically called for in these specifications were used as the basis of the fire suppression systems design; modifications to the systems design to accommodate a substituted piece of equipment shall be the responsibility of the installing Contractor.

B. Coordinate all substituted equipment requirements with other trades prior to ordering equipment.

1.08 RECORD DOCUMENTS

A. Keep in custody during entire period of construction, a current set of documents indicating changes that have been made due to field conditions. Changes to be noted on the documents shall include

but shall not be limited to piping installed more than 2'-0” from where shown on Drawings, changes in pipe size, location of valves. Mark valve tag numbers on Drawings. Incorporate Addenda, accepted Alternates, Change Orders, and other Document revisions which occurred after the award of the General Contract or the start of construction activities into the Record Documents. Notations and changes shall be done in a neat and legible manner in accordance with Architect's instructions. Changes shall be noted in red, deletions in green, and notes in blue.

B. Upon completion of work, submit the complete set of Record Documents to the Architect. The Contract Documents set the standard for content and methods of presentation for the changes shown.

C. The Contract shall not be considered completed until these Record Documents have been reviewed and accepted by the Architect.

1.09 DELIVERY, STORAGE, HANDLING

A. Provide delivery and safe storage of materials and equipment. Make provisions for introduction into building of equipment too large to pass through finished openings. Provide for hoisting of equipment.

1.10 PROTECTION OF EQUIPMENT

A. Protect materials and equipment from physical damage, construction dirt, and the elements from time of shipment to time installation is accepted by Owner.

B. Protect mechanical work against theft, injury, or damage from all causes.

1.11 GUARANTEE

A. Reference "General Conditions" for warranty periods and conditions except for special conditions and warranties, which shall be identified and listed within the appropriate individual sections.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 EQUIPMENT WIRING AND CONNECTIONS

A. Voltage characteristics shall be as in Electrical Division of Specifications and on Electrical Drawings.

3.02 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Provide temporary power supply or other facilities required for Work. Arrange with proper parties to bring facilities from services to required location on premises.

3.03 INSPECTIONS

A. Do not cover up or enclose work until inspected, tested, and approved. Any work enclosed or covered up before such approval shall be uncovered, tested, and approved.

3.04 ACCESS DOORS

A. Furnish hinged steel access doors with concealed latch, whether shown or not, in walls and plaster or gypsum board ceilings for access to concealed valves or other operating devices requiring adjustment or servicing.

B. Access door shall be size of equipment to be removed or 24” by 24” if used for service only.

C. Furnish doors to trades performing work in which they are to be installed. Group valves, devices, and other equipment, to permit use of minimum number of access doors.

D. Doors shall be type compatible with finish in which they are to be installed.

3.05 SUPERVISION

A. Supervise work to proceed in proper sequence without delay to other contractors. Keep supervisor on premises at all times to ensure intent of Drawings and Specifications is being followed.

3.06 INSTALLATION

A. Workmanship shall be first quality. Appearance of work shall be of equal importance to its mechanical operation. Lack of quality workmanship shall be reason for rejection of system in part or in whole.

B. Install so all valves and equipment can be easily accessed and serviced by adequate clearance, installation of access doors, unions in piping, or other methods.

C. Install equipment and materials per manufacturers' recommendations and local codes or regulations.

D. Flush pipes free of foreign substances before installing valves or making final connections. Notify the Owner 7 days in advance of final flushing so the Owner can verify the cleanliness of the pipe. Clean all piping and equipment.

3.07 TESTING

A. All tests specified herein and/or called for by authorities having jurisdiction shall be witnessed by Architect or Owner. Reference other Division Sections for additional requirements specific to those sections.

B. Upon completion of the work, deliver certificates of inspection and final approval to Owner.

3.08 COMPLETION

A. Instruct Owner in operation and maintenance of fire suppression systems.

B. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and appearance.

C. On completion of work, remove tools, scaffolding, debris, etc., from grounds and leave premises clean.

3.09 PROJECT CLOSE-OUT

A. Upon written notice from the Contractor certifying the work is complete and ready for inspection, Engineer will prepare punchlist of items determined to be incomplete or otherwise not incompliance with intent of Contract Documents.

B. When requested, a confirmation visit to review completion of punchlist work will be made after receipt of written statement from Contractor indicating punchlist work is complete. Include copies of intermediate observation reports and final punchlists with individual items initialed by Contractor to attest that individual work items are completed.

C. Contractor shall pay Engineer's costs at the billing rates in effect at the time the services are performed for subsequent visits to the site required due to insufficient completion of work outlined on the punch list report.

3.10 OPERATION AND MAINTENANCE MANUALS

A. Prior to completion of project, submit three (3) sets of maintenance manuals covering operation and maintenance of fire suppression equipment with moving or movable parts. Instructions shall be in pamphlet or typewritten form in three ring binders. Instructions for each system or item of equipment shall be indicated by separate tab.

1. Maintenance manuals submitted in electronic form shall be provided in separate Portable Document Format (pdf) folders for each system or item of equipment installed.

B. Include valve tag list.

C. Include name, address, telephone number of party to be contacted for 24-hour service for each item of equipment.

D. Include starting, stopping, lubrication, preventative maintenance schedule, and adjustment information for each piece of equipment.

E. Include guarantees and warranties of all equipment.

END OF SECTION

SECTION 210500
COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Above ground piping.

B. Escutcheons.

C. Pipe, fittings, sleeves, escutcheons, seals, and connections for sprinkler systems.

D. Mechanical couplings.

E. Pipe hangers and supports.

F. Pipe sleeves.

1.02 REFERENCE STANDARDS

A. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

B. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

C. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

D. ASME B16.4 - Gray Iron Threaded Fittings: Classes 125 and 250; 2016.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

F. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

G. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.

H. ASTM A795/A795M - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use; 2021.

I. AWWA C606 - Grooved and Shouldered Joints; 2015.

J. NFPA 13 - Standard for the Installation of Sprinkler Systems; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.03 SUBMITTALS

A. Product Data: Provide manufacturers catalogue information for materials and products specified under this section. Indicate valve data and ratings.

B. Shop Drawings: Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.

C. Welding certificates.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13, Include "Contractor's Material and Test Certificate for Aboveground Piping."

E. Project Record Documents: Record actual locations of components and tag numbering.

F. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

G. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Installer Qualifications: Company specializing in performing work of the type specified this section.
   1. Minimum three years experience.

C. Installer qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
   2. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional fire protection engineer.

D. Welding Qualifications: Qualify procedures and operators according to AMSE boiler and pressure vessel code.

E. NFPA Standards: sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA13, "Installation of Sprinkler Systems."

F. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store valves in shipping containers, with labeling in place.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until sprinkler installation.

1.06 WARRANTY

A. See Section 017800 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 FIRE PROTECTION SYSTEMS

A. Sprinkler Systems: Conform to NFPA 13.

B. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 ABOVE GROUND PIPING

A. Steel Pipe: ASTM A795 Schedule 10 or ASTM A53 Schedule 40, black.
   1. Cast Iron Fittings: ASME B16.1, flanges and flanged fittings and ASME B16.4, threaded fittings.
   2. Malleable Iron Fittings: ASME B16.3, threaded fittings and ASTM A47/A47M.
   3. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts, and washers; galvanized for galvanized pipe.
      a. Manufacturers:
         1) Anvil International, Inc.
         2) Gruvlock
         3) Corcoran Piping System Co.
         4) National Fittings, Inc.
         5) Shurjoint Piping Products.
         6) Tyco Fire & Building Products LP.

7) Victaulic Company.

4. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement onto pipe.

2.03 PIPE SLEEVES

A. Vertical Piping:
1. Sleeve Length: 1 inch above finished floor.
2. Provide sealant for watertight joint.

2.04 ESCUTCHEONS

A. Material:
1. Metals and Finish: Comply with ASME A112.18.1.

B. Construction:
1. One-piece for mounting on chrome-plated tubing or pipe and one-piece or split-pattern type elsewhere.
2. Internal spring tension devices or setscrews to maintain a fixed position against a surface.

2.05 PIPE HANGERS AND SUPPORTS

A. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Malleable iron, adjustable swivel, split ring.

B. Hangers for Pipe Sizes 2 inches and Over: Carbon steel, adjustable, clevis.

2.06 MECHANICAL COUPLINGS

A. Rigid Mechanical Couplings for Grooved Joints:
1. Dimensions and Testing: Comply with AWWA C606.
2. Minimum Working Pressure: 300 psig.
3. Housing Material: Fabricate of ductile iron conforming to ASTM A536.
4. Housing Coating: Factory applied orange enamel.
5. Gasket Material: EPDM suitable for operating temperature range from minus 30 degrees F to 230 degrees F.
6. Bolts and Nuts: Hot dipped galvanized or zinc electroplated steel.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and foreign material, from inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 GENERAL PIPING APPLICATIONS

A. Shop weld pipe joints where welded piping is indicated.

B. Do not use welded joints for galvanized-steel pipe.

C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

D. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.03 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Standard-Pressure, Wet-Pipe Sprinkler System, 175-psig Maximum Working Pressure:

1. 1-1/2-inch and Smaller: Threaded-end, black, standard-weight steel pipe; cast- or malleable-iron threaded fittings; and threaded joints.
2. 2-inch and Larger: Grooved-end, threadable, thinwall steel pipe; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.

3.04 JOINT CONSTRUCTION

A. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than 8-inch (DN 200) with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

B. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.
1. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

C. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials.
1. 2-inch and Smaller: Use dielectric couplings or nipples.
2. 2-1/2-inch to 4-inch: Use dielectric flanges.
3. 5-inch and Larger: Use dielectric flange insulation kits.

3.05 INSTALLATION

A. Install sprinkler system and service main piping, hangers, and supports in accordance with NFPA 13.

B. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

C. Install piping to conserve building space, to not interfere with use of space and other work.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

F. Pipe Hangers and Supports:
1. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
2. Place hangers within 12 inches of each horizontal elbow.
3. Use hangers with 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
4. Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
5. Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.

G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

H. Do not penetrate building structural members unless indicated.

I. Provide sleeves when penetrating footings, floors, walls, and partitions. Seal pipe including sleeve penetrations to achieve fire resistance equivalent to fire separation required.

J. Escutcheons:
1. Install and firmly attach escutcheons at piping penetrations into finished spaces.
2. Provide escutcheons on both sides of partitions separating finished areas through which piping passes.
3. Use chrome plated escutcheons in occupied spaces and to conceal openings in construction.

K. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.06 CLEANING

A. Upon completion of work, clean all parts of the installation.

B. Clean equipment, pipes, valves, and fittings of grease, metal cuttings, and sludge that may have accumulated from the installation and testing of the system.

3.07 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
   3. Energize circuits to electrical equipment and devices.
   4. Flush, test, and inspect sprinkler systems according to NFPA 13 and NFPA 24, "Systems Acceptance" Chapters.
   5. Coordinate with fire alarm tests. Operate as required.
   6. Verify that equipment hose threads are same as local fire department equipment.

B. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.08 CLEANING AND PROTECTION

A. Flush piping systems prior to final connections.

B. Maintain protective covers over open ended piping sections until final sprinkler connections are made.

3.09 DEMONSTRATION

A. Engage a service representative to train Owner's maintenance personnel to adjust, operate, service and maintain system components and specialties.

END OF SECTION

SECTION 211300
FIRE SUPPRESSION SPRINKLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Wet-pipe sprinkler system and components.

B. System design, installation, and certification requirements.

1.02 SYSTEM DESCRIPTION

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.03 PERFORMANCE REQUIREMENTS

A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.

B. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

C. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.

D. Minimum Density for Automatic-Sprinkler Piping Design:
1. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
2. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
3. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.

E. Maximum Protection Area per Sprinkler:
1. Office Spaces: 225 sq. ft..
2. Storage Areas: 130 sq. ft..
3. Mechanical Equipment Rooms: 130 sq. ft..
4. Electrical Equipment Rooms: 130 sq. ft..
5. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

F. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
1. Light-Hazard Occupancies: 100 gpm for 30 minutes.
2. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.04 SUBMITTALS

A. See Division 01 for submittal requirements.

B. Product Data: Provide manufacturers catalogue information for materials and products specified under this section. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Fire-hydrant flow test report.

D. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Shop Drawings: For water-based automatic fire sprinkler systems. Include plans, elevations, sections, details, and attachments to other work; include required information as outlined in NFPA 13 and as required by the Authority Having Jurisdiction (AHJ).
1. Coordinate fire sprinkler system design with other trades and identify areas where conflicts exist; resolve conflicts prior to shop drawing submittal.

2. Submit preliminary layout of finished ceiling areas indicating only sprinkler locations coordinated with ceiling installation.
3. Submit initial shop drawings through General Contractor for review by Architect prior to review by Owner and AHJ; make noted corrections and submit for approval through the Owner and the AHJ.
    a. Identify all locations where exposed piping systems are proposed to be installed.
4. Indicate hydraulic calculations, detailed pipe layout, hangers and supports, sprinklers, components and accessories. Indicate system controls.
5. Submit shop drawings to authority having jurisdiction for approval. Submit proof of approval to architect as part of design team final submittal review package.

F. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.
1. Submit record drawings (One set of reproducible documents) for review and approval within thirty (30) working days of completion of the fire sprinkler system. After review, submit the final, corrected drawings in print and electronic form on computer disc or CD ROM to the Owner or his designated representative. Record drawings shall include all shop drawing information outlined above as well as the following:
    a. System components as installed, including all deviations from the approved shop drawings as approved by the AHJ.
    b. Dependent upon the amount of field modifications incorporated into the building, the Owner may request supplemental hydraulic calculations to verify the adequacy of the system installation in the “as-built” condition.
    c. Electronic record documents shall be provided in format as requested by the Owner.

G. Operation and Maintenance Data: Include components of system, servicing requirements, record drawings, inspection data, replacement part numbers and availability, and location and numbers of service department.
1. Manual shall be submitted and approved prior to conducting training sessions.
2. Manual shall contain a complete training session outline (agenda).
3. Manual shall contain all system test certificates and field quality-control reports.

H. Project Record Documents: Record actual locations of sprinklers and deviations of piping from drawings. Indicate drain and test locations.

1.05 QUALITY ASSURANCE

A. Conform to UL requirements.

B. Designer Qualifications: Design system under direct supervision of a Professional Fire Protection Engineer or NICET Level III experienced in design of this type of work and licensed in the state of Colorado.

C. Equipment and Components: Provide products that bear UL label or marking.

D. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Store products in shipping containers and maintain in place until installation. Provide temporary inlet and outlet caps. Maintain caps in place until installation is complete.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Sprinklers:
1. AFAC Inc.
2. Firematic Sprinkler Devices, Inc.

3. Grinnell Fire Protection.
4. Reliable Automatic Sprinkler Co., Inc.
5. Tyco Fire Suppression & Building Products.
6. Victaulic Co. of America.
7. Viking Corp.

B. Alarm Devices:
1. ADT Security Services, Inc.
2. Grinnell Fire Protection.
3. Potter Electric Signal Company.
4. System Sensor.
5. Viking Corp.

C. Pressure Gauges:
1. AGF Manufacturing Co.
2. AMETEK, Inc.; U.S. Gauge.
3. Brecco Corporation.
4. Dresser Equipment Group; Instrument Div.
5. Marsh Bellofram.
6. WIKA Instrument Corporation.

D. Sprinkler Specialty Fittings:
1. Fire-End and Croker Corp.
2. Tyco Fire Suppression & Building Products.
3. Viking Corp.
4. Victaulic Co. of America.

2.02 SPRINKLER SYSTEM

A. Sprinkler System: Provide coverage for building areas noted.

B. Occupancies: Light hazard and ordinary hazard groups 1 and 2.

C. Water Supply: Determine volume and pressure from water flow test data.

2.03 SPRINKLERS

A. Suspended Grid Ceiling Type: Recessed pendant type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

B. Exposed Area Type: Pendant type with guard.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Brass.
4. Fusible Link: Glass bulb type temperature rated for specific area hazard.

C. Sidewall Type: Semi-recessed horizontal sidewall type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Coverage Type: Standard.
3. Finish: Chrome plated.
4. Escutcheon Plate Finish: Chrome plated.
5. Fusible Link: Glass bulb type temperature rated for specific area hazard.

D. Dry Sprinklers: Concealed pendant type with matching push on escutcheon plate.
1. Response Type: Quick.
2. Fusible Link: Fusible solder link type temperature rated for specific area hazard.

E. Guards: Finish to match sprinkler finish.

F. Flexible Drop System: Stainless steel, multiple use, open gate type.
   1. Application: Use to properly locate sprinkler heads.
   2. Include all supports and bracing.
   3. Provide braided type tube as required for the application.
   4. Manufacturers:
      a. Victaulic Company; Vic-Flex: www.victaulic.com/#sle.
      b. Substitutions: See Division 01 for product requirements.

G. Suspended Hard Lid Ceiling Type: Concealed pendant type with matching push on escutcheon plate.
   1. Finish: Brass.
   2. Escutcheon Plate Finish: Enamel, color as selected by architect.
   3. Fusible Link: Glass bulb type temperature rated for specific area hazard.

2.04 PIPING SPECIALTIES

A. Test Connections:
   1. Backflow Preventer Test Connection:
      a. Provide downstream of the backflow prevention assembly, listed hose valves with 2.5 inch National Standard male hose threads with cap and chain.
      b. Furnish one valve for each 250 gpm of system demand or fraction thereof.

2.05 FIRE DEPARTMENT CONNECTIONS:

A. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR."
   1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
   2. Finish: Polished chrome-plated.

2.06 ALARM DEVICES:

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

C. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

2.07 PRESSURE GAUGES:

A. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
   1. Water System Piping: Include caption "WATER" on dial face.

2.08 BACKFLOW PREVENTERS:

A. General: ASSE standard, Double check valve type assembly backflow preventers.
   1. 6 inch: Bronze, cast-iron, or steel,body with flanged or grooved ends.
      a. Interior Lining: AWWA C550 or FDA-approved, epoxy coating for backflow preventers having cast-iron or steel body.
   2. Interior Components: Corrosion-resistant materials.

3. Flow Pattern: Straight line pattern.
4. Strainer: On inlet, if indicated.

2.09 SPRINKLER SPECIALTY FITTINGS:

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping.

B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

PART 3 EXECUTION

3.01 PREPARATION

A. Flow Test Data: Obtain fire-hydrant flow test data from jurisdictional fire department, or perform fire hydrant flow test where jurisdictional fire department is unable to provide required data. Use results from flow test for system design calculations required in Part 1.
1. Reduce data by factors outlined by jurisdicational authority prior to performing calculations for system design.

B. Report results promptly and in writing to the Owner.

3.02 INSTALLATION

A. Install in accordance with referenced NFPA design and installation standard.

B. Install equipment in accordance with manufacturer's instructions.

C. Provide approved double check valve assembly at sprinkler system water source connection.

D. Install wall-type, fire department connections in vertical wall.

E. Locate outside alarm gong on building wall as indicated.

F. Place pipe runs to minimize obstruction to other work.

G. Place piping in concealed spaces above finished ceilings.

H. Center sprinklers in center of narrow dimension of acoustical ceiling panels or tiles.

I. Apply masking tape or paper cover to ensure concealed sprinklers, cover plates, and sprinkler escutcheons do not receive field paint finish. Remove after painting. Replace painted sprinklers.

J. Flush entire piping system of foreign matter.

K. Install guards on sprinklers where indicated.

L. Hydrostatically test entire system.

M. Require test be witnessed by Fire Marshal.

3.03 INTERFACE WITH OTHER PRODUCTS

A. Ensure required devices are installed and connected as required to fire alarm system.

3.04 SCHEDULES

A. System Hazard Areas:
1. Offices and Public Areas: Light Hazard.

2. Building Service Areas, General Storage and Equipment Rooms: Ordinary Hazard, Group 1.

END OF SECTION

SECTION 220100
BASIC PLUMBING REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL CONDITIONS

A. The General Conditions of the Contract and Supplementary Conditions of the General Contract apply to work under this Division.

1.02 QUALITY ASSURANCE

A. The design for this project is based on specific manufacturers and equipment as scheduled on the drawings and listed in these Division Specifications with specific model number identifiers. Acceptable substitute manufacturers of equipment are listed in these specifications. If any acceptable substitute manufacturer's equipment is used, the cost of any change in design or construction required by their use shall be borne by the contractor. Contractor shall document and submit all changes to design plans and schedules as a result of the use of substituted equipment.

B. If manufacturer's material or equipment is listed in Schedules or on Drawings, they are types to be provided for establishment of size, capacity, grade, and quality. If other acceptable manufacturers are used, cost of any change in construction required by their use shall be borne by Contractor.

C. Equipment shall conform to State and/or local Energy Conservation Standards.

D. Execute and test all work per Underwriters, state and local codes, rules, and regulations applicable to trade affected. Included are recommendations of NFPA, OSHA, and ASHRAE. References to standards are latest revision of standard specified.

E. All equipment and materials used in the distribution of domestic potable water shall be approved and tested for such application with documented listings and labeling in accordance with the latest edition of the [International Plumbing Code, Public Law 111-380 and ANSI/NSF-61, Annex G].

1.03 INTENT AND INTERPRETATIONS

A. It is the intent of these Drawings and Specifications to result in a complete plumbing installation in complete accordance with all applicable codes and ordinances.

B. Drawings are diagrammatic in character and do not necessarily indicate every required pipe, offset, transition, etc. Items not specifically mentioned in the Specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.

C. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. The more stringent requirements shall govern.

D. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, take the necessary measurements and prepare the drawings.

E. Symbols used on the Drawings are defined in the Legend on the Drawings. All symbols indicated on the Legend may not necessarily be required for the project.

F. “Provide” shall mean “furnish and install.” “Accepted” or “acceptable” denotes the work or equipment item is in conformance with the design concept of the project and, in general, complies with the pertinent information given in the Contract Documents.

G. Prior to ordering equipment, determine that equipment will adequately pass through building openings and passageways providing unobstructed access to final equipment location. Equipment shall be manufactured and shipped in sections for assembly in final equipment location when inadequate building openings and passageways limit access. Shop drawings and submittals shall indicate sectionalized manufacturing of equipment.

H. Before any work is installed, determine equipment will properly fit the space, required clearances can be maintained and equipment can be located without interferences between systems, with structural elements, or with the work of other trades.

I. If conflicts are discovered in Contract Documents as work progresses, submit a set of drawings marked with red pencil showing recommended modifications to the Architect for approval prior to installation.

J. The Drawings indicate the general arrangement of system components. However, rearrangement will not be permitted without specific approval prior to installation.

K. Provide incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like whether listed or not.

L. Provide labor, fees, licenses, start-up and checkout services.

M. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Architect in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply all necessary materials and labor required for the proper completion of this work.

1.04 JOB CONDITIONS

A. Location, size, and type of equipment and material shown as existing are taken from existing drawings and limited field survey. Verify exact conditions in field prior to start of construction.

B. Before submitting bid, examine premises and become familiar with all existing conditions which may affect cost. No allowance will subsequently be made for not following this procedure.

C. Not all piping and offsets, transitions, and multiple connections required to install the new work into the available space are shown on the drawings. Field measure for exact requirements and install accordingly.

D. Where locations of devices and equipment are not specifically mentioned in the Specifications or indicated on the Drawings, verify locations with Architect or Owner prior to rough-in.

E. Submit large scale coordinated composite layouts showing both plan and elevation, piping, ducts, and conduits in areas that appear congested. Check routing of work prior to fabrication. Report conflicts to Architect.

F. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.

1.05 PERMITS AND FEES

A. Arrange and pay for all inspections, permits, licenses, certificates, and fees required in connection with work.

1.06 SUBMITTALS

A. Conform to requirements of Division 01 and following paragraphs.

B. All electronic submittal data shall be provided in separate Portable Document Format (pdf) folders for each individual Division specification section.

C. Submittals shall include catalog cut-sheets, manufacturer's data sheets, written descriptions, and specification sheets detailing the associated product, item, and assembly. Reference the Division Sections for additional information and requirements specific to those sections.
   1. Resubmittals shall include information required above, along with reference to original submittal section tab being corrected.

D. Prior to ordering equipment or beginning installation work, assemble, prepare, and furnish submittals required for project. Furnish submittals as required by individual sections of specifications.

E. Contractor shall thoroughly check subcontractors' or vendors' submittals and, after approving them, submit them for review. Submittals that do not bear Contractor's review stamp or that do not comply with all of the above requirements will be returned “Not Reviewed.”

F. Submittals shall identify specific equipment with numbers or letters identical to those listed or scheduled on the Drawings or Specifications.

1.07 SUBSTITUTIONS

A. Equipment scheduled on drawings and specifically called for in these specifications was used as the basis of the mechanical systems design; modifications to the systems design to accommodate a substituted piece of equipment shall be the responsibility of the installing Contractor.

B. Coordinate all substituted equipment requirements with other trades prior to ordering equipment.

C. Submittals shall not be used for requesting approval for substitute equipment.

1.08 RECORD DOCUMENTS

A. Keep in custody during entire period of construction, a current set of documents indication changes that have been made to the Contract Documents. Changes to be noted on the documents shall include but shall not be limited to piping installed more than 2'-0” from where shown on Drawings, changes in pipe size, location of valves and cleanouts. Incorporate Addenda, accepted Alternates, Change Orders, and other Document revisions which occurred after the award of the General Contract or the start of construction activities into the Record Documents. Notations and changes shall be done in a neat and legible manner in accordance with Architect's instructions. Changes shall be noted in red, deletions in green, and notes in blue.

B. Upon completion of work, submit the complete set of Record Documents to the Architect. The Contract Documents set the standard for content and methods of presentation for the changes shown.

C. The Contract shall not be considered completed until these Record Documents have been reviewed and accepted by the Architect.

1.09 DELIVERY, STORAGE, HANDLING

A. Provide delivery and safe storage of materials and equipment. Make provisions for introduction into building of equipment too large to pass through finished openings. Provide for hoisting of equipment.

1.10 PROTECTION OF EQUIPMENT

A. Protect materials and equipment from physical damage, construction dirt, and the elements from time of shipment to time installation is accepted by Owner.

B. Protect mechanical work against theft, injury, or damage from all causes.

1.11 GUARANTEE

A. Reference " General Conditions" for warranty periods and conditions except for special conditions and warranties, which shall be identified and listed within the appropriate individual sections.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 EQUIPMENT WIRING AND CONNECTIONS

A. Voltage characteristics shall be as in Electrical Division of Specifications and on Electrical Drawings.

3.02 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Provide temporary power supply or other facilities required for Work. Arrange with proper parties to bring facilities from services to required location on premises.

3.03 INSPECTIONS

A. Do not cover up or enclose work until inspected, tested, and approved. Any work enclosed or covered up before such approval shall be uncovered, tested, and approved.

3.04 SUPERVISION

A. Supervise work to proceed in proper sequence without delay to other contractors. Keep supervisor on premises at all times to ensure intent of Drawings and Specifications is being followed.

3.05 INSTALLATION

A. Workmanship shall be first quality. Appearance of work shall be of equal importance to its mechanical operation. Lack of quality workmanship shall be reason for rejection of system in part or in whole.

B. Complete installation shall function smoothly and noiselessly.

C. Install equipment and materials per manufacturers' recommendations and local codes or regulations.

3.06 LUBRICATION OF EQUIPMENT

A. Lubricate equipment before operation and before turning over to Owner.

3.07 TESTING

A. All tests specified herein and/or called for by authorities having jurisdiction shall be witnessed by Architect or Owner. Reference other Division Sections for additional requirements specific to those sections.

B. Upon completion of the work, deliver certificates of inspection and final approval to Owner.

3.08 COMPLETION

A. Instruct Owner in operation and maintenance of mechanical systems. Minimum participants shall include mechanical contractor.

B. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and appearance.

C. On completion of work, remove tools, scaffolding, debris, etc., from grounds and leave premises clean.

3.09 PROJECT CLOSE-OUT

A. Upon written notice from the Contractor certifying the work is complete and ready for inspection, Engineer will prepare punchlist of items determined to be incomplete or otherwise not incompliance with intent of Contract Documents.

B. When required, subsequent visit to review completion of punchlist work will be made after receipt of written statement from Contractor indicating punchlist work is complete. Include copies of intermediate observation reports and final punchlists with individual items initialed by Contractor to attest that individual work items are completed.

C. Contractor shall pay Engineer's costs at the billing rates in effect at the time the services are performed for subsequent punch list visits required due to lack of completion of previous punch list.

3.10 OPERATION AND MAINTENANCE MANUALS, AS-BUILT DRAWINGS

A. Prior to completion of project, submit three (3) sets of maintenance manuals covering operation and maintenance of mechanical equipment with moving or movable parts. Instructions shall be in pamphlet or typewritten form in three ring binders. Instructions for each unit shall be indicated by separate tab.
   1. Maintenance manuals submitted in electronic form shall be provided in separate Portable Document Format (pdf) folders for each system or item of equipment installed.

B. Include valve tag list.

C. Include name, address, telephone number of party to be contacted for 24-hour service for each item of equipment.

D. Include starting, stopping, lubrication, preventative maintenance schedule, and adjustment information for each piece of equipment.

END OF SECTION

SECTION 220500
COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Escutcheons.
4. Grout.
5. Plumbing demolition.
6. Equipment installation requirements common to equipment sections.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

C. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.04 SUBMITTALS

A. Product Data: For the following:

B. Welding certificates.

1.05 QUALITY ASSURANCE

A. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

B. All equipment and materials used in the distribution of domestic potable water shall be approved and tested for such application with documented listings and labelings in accordance with the latest edition of the [International Plumbing Code, Public Law 111-380 and ANSI/NSF-61, Annex G].

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.07 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.03 JOINING MATERIALS

A. Refer to individual Division piping Sections for special joining materials not listed below.

B. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

C. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.04 TRANSITION FITTINGS

A. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
   1. Manufacturers:
      a. Cascade Waterworks Mfg. Co.
      b. Fernco, Inc.
      c. Mission Rubber Company.
      d. Plastic Oddities, Inc.

2.05 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.06 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.
   3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.01 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.02 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division Sections specifying piping systems.

B. All piping systems installed with ceiling plenum spaces shall meet the requirements of and be listed in compliance with ASTM E-84, Standard Test Method for Surface Burning Characteristics of Building Materials.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
   1. Individual fixture supplies, exposed within finished spaces shall be polished chrome plated.
   2. Drainage tubing, including p-traps, waste arms and tailpieces for individual or multiple fixtures shall be polished chrome plated; sanitary and vent stacks exposed within finished spaces shall be pimed and painted per division 9.
   3. Indirect waste tubing, exposed within finished spaces shall be polished chrome plated.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install restraints for hubless pipe couplings in drainage system applications to prevent joint separation caused by forces resulting from intermittent flow volumes.

J. Install sway bracing to restrict lateral movement caused by velocity forces within horizontal and vertical piping systems.

K. Install anchorages to restrain and prevent axial movement in piping systems.

L. Install fittings for changes in direction and branch connections.

M. Install piping to allow application of insulation.

N. Select system components with pressure rating equal to or greater than system operating pressure.

O. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
      g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than 6-inches.

Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

3.03 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

3.04 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping 2-inches and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.05 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.06 PAINTING

A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.07 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 220523
GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

1.02 RELATED REQUIREMENTS

A. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

C. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).

D. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984 (Reapproved 2019)e1.

E. ASTM B62 - Standard Specification for Composition Bronze or Ounce Metal Castings; 2017.

F. MSS SP-67 - Butterfly Valves; 2017.

G. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves; 2013.

H. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

I. NSF 61 - Drinking Water System Components - Health Effects; 2020.

J. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

A. See Division 01 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Minimize exposure of operable surfaces by setting plug and ball valves to open position.
   2. Protect valve parts exposed to piped medium against rust and corrosion.
   3. Protect valve piping connections such as grooves, weld ends, threads, and flange faces.

B. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.

2. Store valves in shipping containers and maintain in place until installation.
    a. Store valves indoors in dry environment.
    b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. See drawings for specific valve locations.

B. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

C. Provide the following valves for the applications if not indicated on drawings:
1. Shutoff: Ball.
2. Swing Check (Horizontal):
    a. 2 NPS and Smaller: Bronze swing check valves with bronze or nonmetallic disc.
    b. 2-1/2 NPS and Larger for Domestic Water: Stainless steel swing check valves with center-guided, resilient seat check valves.

D. Domestic, Hot and Cold Water Valves:
1. 2 inch and Smaller:
    a. Ball: Two piece, full port, brass or bronze with stainless-steel trim.
2. 2-1/2 inch and Larger:
    a. Iron Full-Lug Butterfly: 200 CWP, EPDM seat, stainless-steel disc.

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
1. Hand Lever: Quarter-turn valves 6 inch and smaller except plug valves.

D. Insulated Piping Valves: With 2 inch stem extensions and the following features:
1. Ball Valves: Extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:
1. Threaded End Valves: ASME B1.20.1.
2. Solder Joint Connections: ASME B16.18.

F. General ASME Compliance:
1. Solder-joint Connections: ASME B16.18.

2.03 **VALVE MANUFACTURERS**

A. Ball Valves:
1. Apollo Valves; 77FLF-240 Series SS ball and stem (lead free, solder ends) 77FLF-140 SS ball and stem (lead free, NPT threaded ends): www.apollovalves.com/#sle. Apollo International is not acceptable.

B. Butterfly Valves:
1. Apollo Valves: www.apollovalves.com/#sle.

C. Check Valves:
1. Apollo Valves: www.apollovalves.com/#sle.

2.04 BRONZE, BALL VALVES

A. General:

1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Stainless Steel Trim:
1. Comply with MSS SP-110.
2. WSP Rating: 150 psi.
3. WOG Rating: 600 psi.
4. Body: Forged bronze.
5. Ends Connections: Pipe thread or solder.
6. Seats: TFE.
7. Stem: Stainless steel.
8. Ball: Stainless steel, vented.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bi-directional dead-end service without use of downstream flange:
1. Class 125 or Class 150 flanges.
2. Comply with MSS SP-67, Type I.
3. Lug Style, Service Pressure Ratings:
a. 100 psi for sizes 14 to 24 inch.
b. 150 psi for sizes 2 to 12 inch.
c. Vacuum down to 29.9 in-Hg.
4. Body Material: ASTM A126, cast iron or ASTM A536, ductile iron.
5. Stem: One or two-piece stainless steel.
6. Seat: EPDM.
7. Disc: Stainless steel.
8. Finish: Epoxy coated.
9. Operator: Gear operator with handwheel over direct-mount actuator base.

2.06 BRONZE, SWING CHECK VALVES

A. General:
1. Fabricate from dezincification resistant material.
2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Class 125: CWP Rating: 200 psig (1380 kPa).
1. Comply with MSS SP-80, Type 3.
2. Design: Y-pattern, horizontal or vertical flow.
3. Body: Bronze, ASTM B62.
4. End Connections: Threaded.
5. Disc: Bronze.

2.07 IRON, CENTER-GUIDED CHECK VALVES

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve be determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Install check valves where necessary to maintain direction of flow as follows:
   1. Swing Check: Install horizontal maintaining hinge pin level.

D. Provide chainwheels on operators for valves 4 NPS and larger where located 96 inches or more above finished floor, terminating 60 NPS above finished floor.

END OF SECTION

SECTION 220529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Strut systems for pipe or equipment support.

B. Beam clamps.

C. Pipe hangers.

D. Pipe supports, guides, shields, and saddles.

E. Anchors and fasteners.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

H. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

I. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2018a.

J. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

L. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

M. FM (AG) - FM Approval Guide; current edition.

N. MFMA-4 - Metal Framing Standards Publication; 2004.

O. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

P. UL (DIR) - Online Certifications Directory; Current Edition.

Q. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
   1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
   2. Coordinate the work with other trades to provide additional framing and materials required for installation.
   3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
   4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
   5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:
   1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 033000.

1.04 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, post-installed concrete and masonry anchors, and thermal insulated pipe supports.

C. Installer's Qualifications: Include evidence of compliance with specified requirements.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 QUALITY ASSURANCE

A. Comply with applicable building code.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Provide required hardware to hang or support piping, equipment, or fixtures with related accessories as necessary to complete installation of plumbing work.

B. Provide hardware products listed, classified, and labeled as suitable for intended purpose.

C. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 1.25. Include consideration for vibration, equipment operation, and shock loads where applicable.

D. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

E. Materials for Metal Fabricated Supports: Comply with Section 055000.

1. Zinc-Plated Steel: Electroplated in accordance with ASTM B633 unless stated otherwise.
2. Galvanized Steel: Hot-dip galvanized in accordance with ASTM A123/A123M or ASTM A153/A153M unless stated otherwise.

F. Corrosion Resistance: Use corrosion-resistant metal-based materials fully compatible with exposed piping materials and suitable for the environment where installed.

2.02 BEAM CLAMPS

A. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

B. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

2.03 PIPE HANGERS

A. Swivel Ring Hangers, Adjustable:
1. MSS SP-58 type 10, epoxy-painted, zinc-colored.
2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. FM (AG) and UL (DIR) listed for specific pipe size runs and loads.

B. Clevis Hangers, Adjustable:
1. Copper Tube: MSS SP-58 type 1, epoxy-plated copper.
2. Standard-Duty: MSS SP-58 type 1, zinc-colored, epoxy plated.
3. UL (DIR) listed: Pipe sizes 2-1/2 to 8 inch.
4. FM (AG) listed: Pipe sizes 2-1/2 to 8 inch.

2.04 PIPE CLAMPS

A. Riser Clamps:
1. For insulated pipe runs, provide two bolt-type clamps designed for installation under insulation.
2. MSS SP-58 type 1 or 8, carbon steel or steel with epoxy plated, plain, stainless steel, or zinc plated finish.
3. UL (DIR) listed: Pipe sizes 1/2 to 8 inch.

2.05 PIPE SUPPORTS, GUIDES, SHIELDS, AND SADDLES

A. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

B. Pipe Shields for Insulated Piping:
1. MSS SP-58 type 40, ASTM A1011/A1011M steel or ASTM A653/A653M carbon steel.
2. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: UV-resistant polypropylene with glass fill.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d. Service Temperature: Minus 40 to 178 degrees F.
   e. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

C. Pipe Supports:
1. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
2. Liquid Temperatures Up to 122 degrees F:
   a. Overhead Support: MSS SP-58 types 1, 3 through 12 clamps.
   b. Support From Below: MSS SP-58 types 35 through 38.

D. Pipe Supports, Thermal Insulated:

1. General Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Provide pipe supports for 1/2 to 30 inch iron pipes.
    d. Insulation inserts to consist of rigid phenolic foam insulation surrounded by 360 degree, PVC jacketing.
2. PVC Jacket:
    a. Pipe insulation protection shields to be provided with ball bearing hinge and locking seam.
    b. Moisture Vapor Transmission: 0.0071 perm inch, when tested in accordance with ASTM E96/E96M.
    c. Minimum Thickness: 60 mil, 0.06 inch.

2.06 ANCHORS AND FASTENERS

A. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

B. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.

C. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

D. Preset Concrete Inserts: Continuous metal strut channel and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
    1. Channel Material: Use galvanized steel.
    2. Manufacturer: Same as manufacturer of metal strut channel framing system.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Equipment Support and Attachment:
    1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
    2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.

3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
4. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

H. Preset Concrete Inserts: Use manufacturer-provided closure strips to inhibit concrete seepage during concrete pour.

I. Secure fasteners according to manufacturer's recommended torque settings.

J. Remove temporary supports.

END OF SECTION

SECTION 220553
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe markers.

1.02 RELATED REQUIREMENTS

A. Division 09 section on identification painting.

PART 2 PRODUCTS

2.01 PLUMBING COMPONENT IDENTIFICATION GUIDELINE

A. Pipe Markers: 3/4 inch diameter and higher.

2.02 PIPE MARKERS

A. Manufacturers:
   1. Brady Corporation; B-350: www.bradycorp.com/#sle.

B. Comply with ASME A13.1.

C. Flexible Tape Marker: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

D. Identification Scheme, ASME A13.1:
   1. Primary: External Pipe Diameter, Uninsulated or Insulated.
   2. Secondary: Color scheme per fluid service.
      a. Water; Potable, Cooling, Boiler Feed, and Other: White text on green background.

2.03 LAY-IN CEILING LABELS.

A. Description: Self adheasive type paper or laminate plastic tape. 3/4 inch wide and 1-1/2 inch long with pre-printed identification.

B. Color: White background with blue lettering.

C. Label Information: Provide identification of equipment, valve, control device, or similar equipment above lay-in ceiling. Label shall include identification as noted on contract documents, or clear identification of unit above ceilng.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive identification products.

3.02 INSTALLATION

A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

B. Install equipment tags with screws or permanent adhesive on or near each item of equipment. Locate signs where accessible and visible

C. Install plastic tape pipe marker around pipe in accordance with manufacturer's instructions.

D. Identify piping, concealed or exposed, with plastic tape pipe markers. Use tags on piping 3/4 inch Identify service, flow direction. Install in clear view and align with axis of piping. Locate

identification not to exceed 20 feet on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

E. Provide ceiling labels to locate valves above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

F. Install preformed and lettered plastic markers completely around pipe in accordance with manufacturer's instructions.

END OF SECTION

SECTION 220719
PLUMBING PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Glass fiber insulation.

B. Jacketing and accessories.

1.02 RELATED REQUIREMENTS

A. Division 07 for firestopping.

B. Division 09 for painting insulation jacket.

C. Section 221005 - Plumbing Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

C. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

D. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

E. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel; 2008 (Reapproved 2018).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

H. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

B. Applicator Qualifications: Company specializing in performing the type of work specified in this section with minimum five (5) years of experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

B. Protect stored insulation materials from damage or moisture penetration, discard and replace damaged materials upon discovery.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER INSULATION

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   5. Manson Insulation Inc: www.isolationmanson.com.
   6. Substitutions: See Division 01 for product requirements.

B. Insulation: ASTM C547 and ASTM C795; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.24 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film with factory applied, pressure sensitive self-sealing lap; moisture vapor transmission when tested in accordance with ASTM E 96/E 96M of 0.02 perm-inches.

D. Vapor Barrier Lap Adhesive: Compatible with insulation.

E. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

F. Fibrous Glass Fabric:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Blanket: 1.0 pcf density.
   3. Weave: 5 by 5.

G. Indoor Vapor Barrier Finish:
   1. Cloth: Untreated; 9 oz/sq yd weight.
   2. Vinyl emulsion type acrylic, compatible with insulation, black color.

H. Insulating Cement: ASTM C449.

2.03 JACKETING AND ACCESSORIES

A. PVC Plastic.
   1. Manufacturers:
      a. Johns Manville Corporation.
      b. P.I.C. Plastics, Inc.
      c. Proto PVC Corporation.
      d. Speedline Corporation.
   2. Jacket: One piece molded type fitting covers and sheet material, off-white color.
      a. Minimum Service Temperature: 0 degrees F.
      b. Maximum Service Temperature: 150 degrees F.
      c. Moisture Vapor Permeability: 0.002 perm inch, maximum, when tested in accordance with ASTM E96/E96M.
      d. Thickness: 10 mil, 0.010 inch.

e. Connections: Brush on welding adhesive.

3. Covering Adhesive Mastic: Compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that piping has been tested before applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

C. Verfiy adequate space allowance has been provided for proper insulation material application.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with North American Insulation Manufacturers Association (NAIMA) National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.

E. Glass fiber insulated pipes conveying fluids below ambient temperature:
1. Provide vapor barrier jackets, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples and vapor barrier mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

F. For hot piping conveying fluids 140 degrees F or less and 1-inch or less in nominal pipe diameter, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

G. For hot piping conveying fluids 140 degrees F or less and larger than 1-inch nominal pipe diameter or conveying fluids over 140 degrees F, insulate flanges and unions at equipment.

H. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Provide standard jackets, with or without vapor barrier, factory-applied or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

I. Inserts and Shields:
1. Application: Piping 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
   a. Provide shields only for piping smaller than 1-1/2 inches in diameter between hanger and insulation.
3. Insert Location: Between support shield and piping and under the finish jacket.
4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

J. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at protrusions, and interruptions. At fire separations, refer to Division 07.

K. Pipe Exposed in Mechanical Equipment Rooms or Finished Spaces (less than 10 feet above finished floor): Finish with PVC jacket and fitting covers.

END OF SECTION

SECTION 221005
PLUMBING PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Sanitary waste piping, buried within 5 feet of building.

B. Sanitary waste piping, above grade.

C. Domestic water piping, above grade.

D. Storm Drainage piping, buried within 5 feet of building

E. Storm drainage piping, above grade.

F. Pipe, pipe fittings and connections for the following piping systems:
   1. Equipment drains and indirect waste.
   2. Balancing valves.
   3. Strainers.

1.02 RELATED REQUIREMENTS

A. Section 220516 - Expansion Fittings and Loops for Plumbing Piping.

B. Section 220519 Meters and Gauges for Plumbing Piping.

C. Section 220529 Hangers and Supports for Plumbing Piping.

D. Section 220719 - Plumbing Piping Insulation.

1.03 REFERENCE STANDARDS

A. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

B. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

C. ASME B31.9 - Building Services Piping; 2020.

D. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.

E. ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings; 2021.

F. ASTM B32 - Standard Specification for Solder Metal; 2020.

G. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

H. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

I. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube; 2016.

J. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings; 2016.

K. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.

L. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

M. ASTM D2665 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings; 2020.

N. ASTM D2855 - Standard Practice for the Two-Step (Primer & Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.

O. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2016.

P. AWWA C651 - Disinfecting Water Mains; 2014.

Q. CISPI 301 - Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications; 2017 (Revised 2018).

R. CISPI 310 - Specification for Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications; 2012 (Revised 2018).

S. NSF 61 - Drinking Water System Components - Health Effects; 2020.

T. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

D. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Perform work in accordance with applicable codes.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

D. Identify pipe with marking including size, ASTM material classification, ASTM specification, potable water certification, water pressure rating and Cast Iron Soil Pipe Institute labeling.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

B. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.07 FIELD CONDITIONS

A. Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Supply Systems: Provide piping, pipe fittings, and solder and flux (if used), that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 SANITARY BUILDING DRAINAGE AND VENT PIPING , BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.
   1. Fittings: ASTM A74, cast iron.

2. Joints: Hub-and-spigot, CISPI HSN compression gasket type with ASTM C 564 neoprene gaskets.

B. PVC Pipe: ASTM D2665. Schedule 40 solid wall
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.03 SANITARY BUILDING DRAINAGE AND VENT PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: Cast iron.
2. Joints: CISPI 310, neoprene gaskets and stainless steel clamp-and-shield assemblies.
3. Joints: CISPI 310, heavy duty neoprene gaskets and stainless steel clamp-and-shield assemblies for piping 4 inch and larger.

2.04 DOMESTIC WATER PIPING, ABOVE GRADE

A. Copper Tube: ASTM B88 (ASTM B88M), Type L (B), Drawn (H).
1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
2. Joints: ASTM B 32, lead-free solder.
a. ASTM B 32, brazed using copper-phosphorus brazing filler metal complying with AWS A5.8 for piping 2-inches and larger.

2.05 STORM WATER PIPING, BURIED WITHIN 5 FEET OF BUILDING

A. Cast Iron Pipe: ASTM A74 service weight.
1. Fittings: Cast iron.
2. Joint Seals: ASTM C564 neoprene gaskets, or lead and oakum.

B. PVC Pipe: ASTM D 2665, schedule 40.
1. Fittings: PVC.
2. Joints: Solvent welded, with ASTM D2564 solvent cement.

2.06 STORM AND OVERFLOW STORM WATER PIPING, ABOVE GRADE

A. Cast Iron Pipe: CISPI 301, hubless, service weight.
1. Fittings: CISPI 301, Cast iron.
2. Joints: ASTM C 1540, heavy duty stainless steel clamp-and-shield assemblies with ASTM C 564, elastomeric sealing sleeve.

2.07 PIPE FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 2 inches and Under:
1. Ferrous Pipe: Class 150 malleable iron threaded unions.
2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.

B. No-Hub Couplings:
1. Gasket Material: Neoprene complying with ASTM C564.
2. Band Material: Stainless steel. Heavy duty.
3. Eyelet Material: Stainless steel.

2.08 DIELECTRIC FITTINGS

A. Are prohibited, use brass fittings between dissimilar metals.

2.09 BALANCING VALVES

A. Calibration: Control flow within five percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

B. Memory-Stop Balancing Valves:
1. Manufacturers:
a. Conbraco Industries: www.conbraco.com.

b. Nibco, Inc: www.nibco.com.
c. Milwaukee Valve Company: www.milwaukeevalve.com.
d. Kitz Corporation of America: www.kitz.com

2. MSS SP-110, ball valve, rated for 400-psig minimum CWP. Include two-piece, copper-alloy body with standard or full-port, chrome-plated brass ball, replaceable seats and seals, threaded or solder-joint ends, and vinyl-covered steel handle with insulation extension and memory-stop device. NSF-61/372.

C. Thermal-Actuated Balancing Valve:
1. Manufacturers:
a. ThermOmegaTech: www.circuitsolver.com
2. Self-contained and fully automatic without additional piping or control mechanisms, capable of regulating the flow of recirculated domestic hot water based on water temperature entering the device regardless of system operating pressure; bypass port allowing for system sanitization and reduced flow when system temperatures are satisfied.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. See Section 220516.

F. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
1. See Section 220719.

G. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Division 08.

H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc-rich primer to welding.

I. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Division 09.

J. Install bell and spigot pipe with bell end upstream.

K. Install hubless coupling restraints on all hubless cast iron drainage piping 4 inches and larger at all changes in direction and at all changes in diameter greater than two pipe sizes.

L. Install manually adjusted balancing valves where indicated and adjust to flow rates indicated. Secure memory stop in balanced position for future reference.

M. Install thermally actuated balancing valves in accordance with manufacturer's instructions, flush system thoroughly prior to installation.
   1. Confirm flow direction prior to installation.
   2. Install in-line strainer upstream of thermally actuated balancing valves where strainers have not been provided on the hot water supply system to the building.
   3. Provide access panels where installed above non-accessible celings and within wall or chase construction.

N. Install water piping to ASME B31.9.

O. Copper Pipe and Tube: Make soldered joints in accordance with ASTM B828, using specified solder, and flux meeting ASTM B813; in potable water systems use flux also complying with NSF 61 and NSF 372.

P. PVC Pipe: Make solvent-welded joints in accordance with ASTM D2855.

Q. Sleeve pipes passing through partitions, walls, and floors.

R. Inserts:
   1. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
   2. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
   3. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
   4. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

S. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

C. Provide balancing valves in water recirculating systems where indicated.

3.05 TOLERANCES

A. Drainage Piping: Establish invert elevations within 1/8 inch vertically of location indicated and slope to drain at minimum of 1/8 inch per foot slope for piping 4 inches and larger; slope piping 3 inches and smaller at 1/4 inch per foot..

B. Water Piping: Slope at minimum of 1/32 inch per foot and arrange to drain at low points.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Tests:
   1. All new piping systems, and portions of existing piping systems which have been altered shall be tested utilizing a hydrostatic test, unless noted otherwise, at the pressures listed below. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
   2. Do not enclose, cover or put piping into operation until it has been tested and approved by authorities having jurisdiction.
   3. Clean and flush systems and obtain approval from Owner's designated representative that systems are ready for testing prior to commencing tests.
   4. Notify Architect, Engineer, and Owner's Project Manager a minimum of 24 hours in advance of each test.

5. Isolate equipment and components which cannot withstand test pressures outlined below from piping systems prior to commencing tests.
    a. Remove components which cannot be isolated and plug or cap openings to withstand specified test pressures.
6. Following testing, drain system, vent vessels and piping to prevent collapse by vacuum.
7. Domestic Water Piping:
    a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
    b. Cap and subject piping to initial static water pressure of 24 psig and inspect for leaks. Increase pressure to 75% of design pressure and reinspect for leaks.Increase pressure to 125 psig or 50 psig above operating pressure, whichever is greater without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
8. Sanitary Drainage and Vent Piping:
    a. Prior to hydrostatic testing, perform smoke testing for all systems or portions of systems to be hydrostatically tested.
        1) Segregate those sections to be tested through the use of temporary plugs.
        2) Introduce smoke into the system utilizing a portable smoke blower and smoke candles, filling the system entirely with smoke.
        3) Once the system is fully charged with smoke, visually inspect all joints fittings and piping sections to ensure no smoke is escaping.
        4) Repair leaks and defects with new materials prior to performing hydrostatic testing.
        5) Submit smoke testing report identifying failed sections fittings or joints and identify repair incorporated.
    b. Test drainage and vent piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 12-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
9. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
10. Prepare reports for tests and for corrective action required. Include the following and submit within 24 hours of each test:
    a. Date, time and place of test.
    b. Duration of test.
    c. Person responsible for testing.
    d. Results of test.
    e. Action taken to correct deficiency.
    f. Outside dry bulb temperature.
    g. Specific section of piping tested.
11. Notify Owner's Project Manager after successful test is completed.

3.07 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed, and clean.

B. Ensure acidity (pH) of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet, or gas form throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.08 SERVICE CONNECTIONS

A. Provide new sanitary sewer services. Before commencing work, check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

END OF SECTION

SECTION 221006
PLUMBING PIPING SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Drains.

B. Cleanouts.

C. Hose bibbs.

D. Wall hydrants.

E. Washing machine boxes and valves.

F. Water hammer arrestors.

G. Mixing valves.

1.02 REFERENCE STANDARDS

A. ASME A112.6.3 - Floor and Trench Drains; 2019.

B. ASME A112.6.4 - Roof, Deck, and Balcony Drains; 2003 (Reaffirmed 2012).

C. ASSE 1019 - Performance Requirements for Wall Hydrant with Backflow Protection and Freeze Resistance; 2011 (Reaffirmed 2016).

D. NSF 61 - Drinking Water System Components - Health Effects; 2020.

E. NSF 372 - Drinking Water System Components - Lead Content; 2020.

F. PDI-WH 201 - Water Hammer Arresters; 2017.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.

C. Certificates: Certify that grease interceptors meet or exceed specified requirements.

D. Project Record Documents: Record actual locations of equipment, cleanouts, backflow preventers, water hammer arrestors.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept specialties on site in original factory packaging. Inspect for damage.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Specialties in Potable Water Supply Systems: Provide products that comply with NSF 61 and NSF 372 for maximum lead content.

2.02 DRAINS

A. Roof Drains and Emergency Roof Drains:

1. Assembly: ASME A112.6.4.
2. Body: Lacquered cast iron with sump.
3. Strainer: Removable cast iron dome with vandal proof screws.
4. Accessories: Coordinate with roofing type:
    a. Membrane flange and membrane clamp with integral gravel stop.
    b. Adjustable under deck clamp.
    c. Roof sump receiver.
    d. Waterproofing flange.
    e. Leveling frame.
    f. Extension sleeve for roof insulation indicated.
    g. Emergency Standpipe Material: Cast iron.
    h. Emergency Standpipe Height: 2-inches above primary drain inlet elevation.
5. Manufacturers:
    a. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
    b. Josam Company: www.josam.com.
    c. MIFAB, Inc: www.mifab.com/#sle.
    d. Watts Drainage Solutions: www.watts.com.
    e. Zurn Industries, L.L.C.: www.zurn.com..

B. Conductor Nozzles (CN-1):
1. Bronze round with straight bottom section.

C. Floor Drains:
1. Manufacturers:
    a. Jay R. Smith Manufacturing Company: www.jrsmith.com.
    b. Josam Company: www.josam.com.
    c. Wade Drains: www.wadedrains.com..
    d. Watts Drainage Solutions: www.watts.com.
    e. Zurn Industries, L.L.C.: www.zurn.com..

D. Floor Drain (FD-1):
1. ASME A112.6.3; lacquered cast iron two piece body with double drainage flange, weep holes, reversible clamping collar, and round, adjustable nickel-bronze strainer.

2.03 CLEANOUTS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jrsmith.com/#sle.
2. Josam Company: www.josam.com/#sle.
3. Tyler Pipe, Wade Div.: www.wadedrains.com
4. Zurn Industries, LLC: www.zurn.com/#sle.

B. Cleanouts at Exterior Surfaced Areas (GCO-1):
1. Round cast nickel bronze access frame and non-skid cover with internal plug, two covers required.
2. 2-way cleanout tee for rodding both directions with risers.

C. Cleanouts at Interior Finished Floor Areas (FCO-1):
1. Lacquered cast iron body with anchor flange, reversible clamping collar, threaded top assembly, and round gasketed scored cover in service areas and round gasketed depressed cover to accept floor finish in finished floor areas.

D. Cleanouts at Interior Finished Wall Areas (WCO-1):
1. Line type with lacquered cast iron body and round epoxy coated gasketed cover, and round stainless steel access cover secured with vandal resistant machine screw.

2.04 HOSE BIBBS

A. Manufacturers (HB-1):
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.

2. Murdock Manufacturing, Inc: www.murdockmfg.com/#sle.
3. Watts Regulator Company: www.wattsregulator.com.
4. Tyler Pipe; Wade Div.: www.wadedrains.com
5. Zurn Industries, LLC: www.zurn.com.

B. Interior Hose Bibbs (HB-1):
1. ASSE 1019, self-drainable with flush-mounting chrome plated box with cover, integral nonremovable hose-connection vacuum breaker or backflow preventer, and concealed outlet.

2.05 HYDRANTS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Tyler Pipe; Wade Div.: www.wadedrains.com
3. Woodford Manufacturing Co.: www.woodfordmfg.com
4. Zurn Industries, LLC: www.zurn.com.

B. Wall Hydrants (WH-1):
1. ASSE 1019; freeze resistant, self-draining type with chrome-plated wall plate hose thread spout, handwheel, and integral vacuum breaker.
2. ASSE 1019, self-drainable with flush-mounting, chrome plated box with cover, integral nonremovable hose-connection vacuum breaker or backflow preventer, casing and operating rod to match wall thickness, concealed outlet, and wall clamp.

2.06 WATER HAMMER ARRESTORS

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jayrsmith.com.
2. Josam Company: www.josam.com
3. Precision Plumbing Products, Inc.: www.pppinc.net.
4. Sioux Chief Manufacturing Company, Inc.: www.siouxchief.com.
5. Tyler Pipe; Wade Div.: www.wadedrains.com
6. Watts Regulator Company, a part of Watts Water Technologies: www.wattsregulator.com.

B. Water Hammer Arrestors (WHA):
1. Stainless steel construction, piston or bellows type sized in accordance with PDI-WH 201, precharged suitable for operation in temperature range -100 to 300 degrees F and maximum 250 psi working pressure.

2.07 BARRIER TYPE TRAP SEAL PROTECTION DEVICES

A. Manufacturers:
1. Jay R. Smith Manufacturing Company: www.jrsmith.com.
2. SureSeal Manufacturing Co.: www.rectorseal.com
3. Green Drains: www.greendrains.com

B. Trap Guard (TG-1):
1. ASSE 1072, neoprene diaphragm and sealing gasket with ABS plastic housing body for insertion into gravity drain outlet connections of sizes 2, 3, and 4-inch diameter piping with compression fit at 80 durometer.

2.08 MIXING VALVES

A. Thermostatic Mixing Valves:
1. Manufacturers:
a. Leonard Valve Company: www.leonardvalve.com.
b. Powers: www.powerscontrols.com.
c. Watts Industries, Inc.: www.watts.com
2. Point of Use Valves: ASSE 1070, lead-free, chrome plated cast brass or bronze body, piston or bellows control mechanism, positive shut-off of hot water when cold water supply is lost, replaceable corrosion-resistant components, including stainless steel piston and liner.

3. Minimum Flow Rate: 0.5 Gallons per minute.
4. Accessories:
    a. Check valve on inlets.
    b. Volume control shut-off valve on outlet.
    c. Stem thermometer on outlet.
    d. Strainer stop checks on inlets.
    e. Wall mounting bracket.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
    1. Size same as drainage piping up to 4-inch. Use 4-inch for larger drainage piping unless larger cleanout is indicated.
    2. Locate at each change in direction of piping greater than 135 degrees.
    3. Locate at minimum intervals of 50 feet for piping 4-inch and smaller and 100 feet for larger piping.
    4. Locate at base of each vertical soil and waste stack.

C. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

D. Encase exterior cleanouts in concrete flush with grade.

E. Install floor cleanouts at elevation to accommodate finished floor.

F. Install approved potable water protection devices on plumbing lines where contamination of domestic water may occur.

G. Install floor drains/floor sinks at low points of surface areas to be drained. Set drainage grates flush with finished floor, unless otherwise indicated.
    1. Install floor-drain/floor sink flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
    2. Install individual traps for floor drains/floor sinks connected to sanitary building drain, unless otherwise indicated.
    3. Position floor drains for ready access to allow for inspection and maintenance.
    4. Set floor drains below elevation of surrounding finished floor to allow floor drainage; set with grates depressed according to the following radii:

H. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
    1. Install roof-drain flashing collar or flange so no leakage occurs between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
    2. Position roof drains for easy access and maintenance.

I. Install frost proof wall hydrants aligned with wall surface, grout gap between hydrant and wall.

J. Install frost proof roof hydrants secured to roof structure; extend dain where specified to nearest approved indirect waste receptor.

K. Install water hammer arrestors in water piping according to PDI-WH 201, complete with accessible isolation valve on hot and cold water supply piping to fixtures and equipment as indicated and where quick closing valves are provided.

L. Install water mixing valves with check stops and shutoff valves on inlets.

M. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs.

N. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

O. Install vent flashing sleeves on stacks passing through roof. Secure over stack flashing according to manufacturer's written instructions.

3.02 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect plumbing specialties to piping specified in other Division 22 Sections.

3.03 PROTECTION

A. Protect specialties during construction period to avoid clogging with dirt and debris and to prevent damage from traffic and other construction related work.

B. Replace damaged specialties and components immediately at no additional cost to the owner.

END OF SECTION

SECTION 223000
PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Commercial gas-fired water heaters.

B. Diaphragm-type compression tanks.

C. In-line circulator pumps.

1.02 RELATED REQUIREMENTS

A. Division 26 for electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ANSI Z21.10.1 - Gas Water Heaters, Volume I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less; 2019, with Errata (2020).

B. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

C. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.

D. NSF 61 - Drinking Water System Components - Health Effects; 2020.

1.04 SUBMITTALS

A. Product Data:
   1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements.
   3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.

B. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Certifications:
   1. Water Heaters: NSF approved.

C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.07 WARRANTY

A. See Division 01 for additional warranty requirements.

B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

A. Manufacturers:
   1. American Water Heaters: www.americanwaterheater.com.
   2. A.O. Smith Water Products Co: www.hotwater.com.
   3. Bock Water Heaters, Inc: www.bockwaterheaters.com.
   4. Rheem Manufacturing Company: www.rheem.com.

B. Commercial Gas-Fired Water Heaters:
   1. Type: Automatic, natural gas-fired, vertical storage.
   2. Minimum Efficiency Required: ASHRAE Std 90.1 I-P.
   3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
   4. Accessories:
      a. Water Connections: Brass.
      b. Dip Tube: Brass.
      c. Drain valve.
      d. Anode: Magnesium.
   5. Applications:
   6. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.

2.02 DIAPHRAGM-TYPE COMPRESSION TANKS (DET-1)

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com.
   2. Bell & Gossett, a xylem brand: www.bellgossett.com.
   3. Taco, Inc: www.taco-hvac.com.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel base, legs or saddles where floor mounted.

C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.

2.03 IN-LINE CIRCULATOR PUMPS (CP-1)

A. Manufacturers:
   1. Armstrong Pumps Inc: www.armstrongpumps.com.
   2. Aurora Pump Co.: www.aurorapumps.com.
   3. Grundfos Pumps Corp.: www.grundfos.com
   4. ITT Bell & Gossett: www.bellgossett.com.
   5. Taco, Inc.: www.taco-hvac.com.

B. Description: Factory-assembled and -tested, single-stage, Non-metallicdirect-drive, in-line, sealless centrifugal pumps as defined in ANSI HI 5.1-5.6.

C. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
   1. Impeller: Corrosion-resistant material.
   2. Motor: Single speed, unless otherwise indicated.

D. Casing: Bronze or stainless steel, rated for 125 psig working pressure, with stainless steel rotor assembly.

E. Impeller: Non-metallic, Bronze, or Stainless steel.

F. Shaft: Ceramic.

G. Seal: Sealless.

H. Drive: Direct.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.

B. Coordinate with plumbing piping and related fuel piping, gas venting, and electrical work to achieve operating system.

C. Domestic Water Heat Exchangers:
   1. Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
   2. Support unit on pipe stand.
   3. Pipe relief valves and drains to nearest floor drain.
   4. Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Provide steam pressure gauge at exchanger inlet.
   5. Provide steam traps and valves as indicated.
   6. Pitch shell for condensate drain to traps.

D. Domestic Water Heating Systems:
   1. Install water heaters on concrete bases.
   2. Install water heaters level and plumb, according to layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   3. Install gas water heaters according to NFPA 54.
   4. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.
   5. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
   6. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.
   7. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-water-heater, relief-valve outlet, with drain piping same as domestic water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
   8. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 22 Section "Plumbing Specialties" for hose-end drain valves.
   9. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages" for thermometers.
   10. Clean and flush after installation. Seal until pipe connections are made.

11. Fill water heaters with water.
12. Charge compression tanks with air.
13. Provide steel pipe support, independent of building structural framing members.
14. Clean and flush prior to delivery to site. Seal until pipe connections are made.

E. Pumps:
1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
2. Provide air cock and drain connection on horizontal pump casings.
3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
6. Align and verify alignment of base mounted pumps prior to start-up
7. Provide electrical interlocking from cooling condensate pump safety switch to associated HVAC unit(s) furnished under other Sections.
8. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.
9. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
10. Install in-line, sealless centrifugal pumps with motor and pump shafts horizontal.
11. Install shutoff valve on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping.
12. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:
    a. On-off status of each pump.
    b. Alarm status.

F. Coordinate BAS, BMS, or Integrated Automation linking between unit controller(s) and remote front-end interface; see Section 251500.

3.02 FIELD QUALITY CONTROL

A. Domestic Water heaters:
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.
2. Perform the following field tests and inspections and prepare test reports:
    a. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
    b. Operational Test: After electrical circuitry has been energized, confirm proper operation.
    c. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

B. Pumps:
1. Engage a factory-authorized service representative to perform startup service.
2. Complete installation and startup checks according to manufacturer's written instructions.
3. Check piping connections for tightness.
4. Perform the following startup checks for each pump before starting:
    a. Verify bearing lubrication.
    b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
6. Start motor.
7. Open discharge valve slowly.

END OF SECTION

SECTION 224000
PLUMBING FIXTURES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Flush valve water closets.

B. Wall hung urinals.

C. Lavatories.

D. Sinks.

E. Electric water coolers.

F. Mop sinks.

1.02 RELATED REQUIREMENTS

A. Division 07 - Joint sealers: Seal fixtures to walls and floors.

B. Section 221005 - Plumbing Piping.

C. Section 221006 - Plumbing Piping Specialties.

D. Division - Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.

B. ASHRAE Std 18 - Methods of Testing for Rating Drinking-Water Coolers with Self-Contained Mechanical Refrigeration; 2008 (Reaffirmed 2013).

C. ASME A112.6.1M - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use; 1997 (Reaffirmed 2017).

D. ASME A112.18.1 - Plumbing Supply Fittings; 2018, with Errata.

E. ASME A112.19.2 - Ceramic Plumbing Fixtures; 2018, with Errata.

F. ASME A112.19.3 - Stainless Steel Plumbing Fixtures; 2017, with Errata.

G. ASME A112.19.5 - Flush Valves and Spuds for Water Closets, Urinals, and Tanks; 2017.

H. ASSE 1070 - Performance Requirements for Water Temperature Limiting Devices; 2015.

I. NSF 61 - Drinking Water System Components - Health Effects; 2020.

J. NSF 372 - Drinking Water System Components - Lead Content; 2020.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Review millwork shop drawings, plans and details to confirm size, depth and clearance requirements associated with fixtures to be provided, submit on required fixtures.

C. Product Data: Provide catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

D. Manufacturer's Instructions: Indicate installation methods and procedures.

E. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.06 WARRANTY

A. Provide three year manufacturer warranty for plumbing fixtures and accessories.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Potable Water Systems: Provide plumbing fittings and faucets that comply with NSF 61 and NSF 372 for maximum lead content; label pipe and fittings.

2.02 REGULATORY REQUIREMENTS

A. Comply with applicable codes for installation of plumbing systems.

2.03 MANUFACTURERS

A. Vitreous China Water Closets, Urinals and Lavatories:
1. American Standard: www.americanstandard-us.com.
2. TOTO: www.totousa.com.

B. Flush Valves:
1. Sloan Valve Co.: www.sloan.com.
2. TOTO: www.totousa.com.

C. Lavatory Faucets:
1. Chicago Faucet Co.
2. Delta Commercial Faucets: www.deltacommercialfaucets.com.
3. Symmons Industries, Inc.: www.symmons.com.

D. Stainless Steel Sinks:
1. Elkay Manufacturing: www.elkay.com.
2. Just Manufacturing: www.justmfg.com.

E. Sink Faucets:
1. Chicago Faucet Co.: www.chicagofaucets.com.
2. Delta Commercial Faucets: www.deltacommercialfaucets.com.
3. Elkay Manufacturing: www.elkay.com.

F. Electric Water Coolers:
1. Elkay Manufacturing: www.elkay.com.

G. Mop Service Basins:
1. Fiat: www.fiatproducts.com.
2. Florestone: www.florestone.com
3. Stern-Williams: www.sternwilliams.com.

H. Fixture Supports and Carriers:
1. Jay R. Smith: www.jrsmith.com.
2. Josam: www.josam.com.
3. Wade: www.wadedrains.com.
4. Zurn Industries: www.zurn.com.

2.04 FLUSH VALVE WATER CLOSETS

A. Water Closets: Vitreous china, Accessible, ASME A112.19.2, elongated rim, floor mounted, siphon jet flush action, china bolt caps.
   1. Flush Valve: Exposed (top spud).
   2. Flush Operation: see schedule.
   3. Trapway Outlet: 4 inch.
   4. Color: White.

B. Water Closets: primary height water closet, vitreous china, ASME A112.19.2, elongated rim, wall hung, siphon jet flush action, china bolt caps.
   1. Flush Valve: Exposed (top spud) .
   2. Flush Operation: see schedule.

C. Flush Valves:
   1. Valve Supply Size: 1 inch.
   2. Manual Operated:
      a. Type: ASME A112.18.1 or ASME A112.19.5; diaphragm type complete with vacuum breaker stops, and accessories.
      b. Supplied Volume Capacity: 1.28 gal per flush.
   3. Sensor-Operated:
      a. Type: ASME A112.19.5; chloramine-resistant clog-resistant dual-seat diaphragm valve complete with vacuum breaker, stops and accessories.
      b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
      c. Supplied Volume Capacity: 1.2 gal per flush.
   4. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.

D. Toilet Seats:
   1. Plastic: Solid, white finish, enlongated shape, open front, slow-closing hinged seat cover, and brass bolts with covers.

E. Water Closet Carriers:
   1. ASME A112.6.1M; adjustable cast iron frame, integral drain hub and vent, adjustable spud, lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.05 WALL HUNG URINALS:

A. Urinals: Vitreous china, ASME A112.19.2, wall hung with side shields and concealed carrier.
   1. Flush Volume: 0.5 gallons, maximum.
   2. Flush Valve: Exposed (top spud) .
   3. Flush Operation: Sensor operated.
   4. Trapway Outlet: Integral.
   5. Supply Size: 3/4 inch.

B. Flush Valves:
   1. Sensor-Operated:
      a. Type: ASME A112.19.5; chloramine-resistant, clog-resistant dual-seat diaphragm valve with vacuum breaker, stops and accessories.
      b. Mechanism: Solenoid-operated piston or electronic motor-actuated operator with low-voltage powered infrared sensor, and mechanical override or override push button.
      c. Supplied Volume Capacity: 1.2 gal per flush.
   2. Exposed Type: Chrome-plated, escutcheon, integral screwdriver stop.

C. Urinal Carriers:
   1. ASME A112.6.1M; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing plate and studs.

2.06 LAVATORIES

A. Wall-Hung Basin:
   1. Vitreous China: Accessible, ASME A112.19.2; white rectangular basin with splash lip, front overflow, soap depression, and hanger. Size as indicated on drawings with 4 inch centerset spacing.

B. Drop-In Basin:
   1. Vitreous China: ASME A112.19.2; self-rimming, white, square shape, back overflow, seal of putty, calking, or concealed vinyl gasket, and white finish. Size as indicated on drawings with 4 inch centerset spacing.

C. Supply Faucet:
   1. ASME A112.18.1; chrome plated combination supply fitting with open grid strainer, water economy aerator with maximum flow of 0.5 gpm, indexed handles.
   2. Two Wristblade Handle, Gooseneck Spout, Supply Faucet: ASME A112.18.1; deck-mount, ceramic cartridge disc valve, and maximum flow of 0.5 gpm, low-flow.

2.07 STAINLESS STEEL SINKS

A. Single Compartment Bowl
   1. ASME A112.19.3; 19-1/2 by 19 by 6 inch outside dimensions 18 gauge, 0.035 inch thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   2. Drain: 3-1/2 inch crumb cup and tailpiece.

B. ASME A112.19.3; 15 by 17.5 by 5.5 inch outside dimensions 18 gauge, 0.035 inch thick, Type 304 stainless steel, self rimming and undercoated, with ledge back drilled for trim.
   1. Drain: 3-1/2 inch crumb cup and tailpiece.

C. Faucets:
   1. Two Handle Faucet:
      a. Spray Type: Full stream spray at 1.75 gpm, maximum.
      b. ASME A112.18.1, ADA Standards, and NSF 61 compliant assembly.
      c. Materials: Stainless steel disc valve on brass body with polished chrome finish.

2.08 ELECTRIC WATER COOLERS

A. Water Cooler: Electric, mechanically refrigerated; surface mounted, ADA compliant; stainless steel top, stainless steel body, vandal resistant, elevated anti-squirt bubbler with stream guard, automatic stream regulator, push button, mounting bracket; integral air cooled condenser and stainless steel grille.
   1. Capacity: 8 gph of 50 degrees F water with inlet at 80 degrees F and room temperature of 90 degrees F, when tested in accordance with ASHRAE Std 18.
   2. Electrical: 115 VAC, 60 Hertz compressor, 6 foot cord and plug for connection to electric wiring system including grounding connector.
   3. Bottle Filler: Materials to match fountain.
   4. Support: Floor mounted support carrier with vertical, rectangular steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
   5. Supply: 3/8-inch with straight pattern loose key 1/4 turn stop valve.
   6. Drain: Grid with 1-1/4-inch minimum horizontal waste and trap complying with ASME A112.18.2.

2.09 MOP SINKS

A. Tiling Flange Construction: Galvanized steel.

B. Material: Precast terrazzo composed of marble chips cast in Portland cement.

C. Type: Rectilinear, standard height.

D. Grid strainer: Stainless steel; integral; removable.

E. Dimensions: As indicated on drawings.

F. Accessories:
   1. 5 feet of 1/2 inch diameter plain end reinforced plastic hose.
   2. Hose clamp hanger.
   3. Mop hanger.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

C. Confirm that millwork is constructed with adequate provision for the installation of counter top sinks and lavatories.

3.02 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings and other components according to manufacturer's written instructions.

B. Install each fixture with trap, easily removable for servicing and cleaning.
   1. Exception: Omit trap on fixtures with integral traps.

C. Install chrome plated rigid supplies to fixtures with loose key 1/4 turn stops, reducers, and escutcheons. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

D. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

E. Provide offset tailpiece drains for each accessible lavatory or counter mounted sink; install p-trap along back wall to maintain required accessible clearances.

F. Install protective shielding guards at all lavatories and sinks designated to comply with ANSI A117.1 accessibility guidelines, where piping is exposed below bowl.

G. Install fixtures and components level and plumb.

H. Install and secure fixtures in place with wall supports and bolts.

I. Install wall mounted fixtures with tubular waste piping attached to supports.

J. Install counter mounted fixtures in and attached to casework.

K. Install faucet flow control fittings with specified flow rates and patterns, if faucets are not available with required rates and patterns include adapters.

L. Install disposer in outlet of each sink indicated to have disposer. Coordinate with Division 26 contractor for control switch installation.

M. Install polished chrome plated escutcheons at piping wall and ceiling penetrations in exposed finished locations and within cabinets and millwork.Use deep pattern escutcheons if required to fully conceal protruding fittings.

N. Seal fixtures to wall and floor surfaces with sealant as specified in Division 07, color to match fixture.

3.04 INTERFACE WITH WORK OF OTHER SECTIONS

A. Prior to ordering fixtures to be set in countertop construction, review millwork shop drawings to confirm size, depth and clearances required will be met.

B. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 CONNECTIONS

A. Piping installation requirements are specified in other sections, drawings indicate general arrangement of piping, fittings and specialties.

B. Connect fixtures with water supplies, stops, risers, traps, soil waste and vent piping. use size fittings required to match fixture.

3.06 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures and trim are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings and other specified components.

C. Inspect installed plumbing fixtures and trim for damage; replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.07 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

B. Operate and adjust faucets and controls. Replace damaged or malfunctioning fixtures, fittings and controls.

3.08 CLEANING

A. Clean plumbing fixtures, faucets and other fittings with manufacturer's recommended cleaning methods and materials.
   1. Remove faucet spouts and strainers, remove sediment and debris, reinstall strainers and spouts.
   2. Remove sediment and debris from drain strainers.

B. After cleaning is completed, inspect factory finished fixtures, faucets and fittings, repair damaged finishes.

3.09 PROTECTION

A. Protect installed products from damage due to subsequent construction operations.

B. Do not permit use of fixtures by construction personnel.

C. Repair or replace damaged products.

END OF SECTION

SECTION 230100
BASIC MECHANICAL REQUIREMENTS

PART 1 GENERAL

1.01 GENERAL CONDITIONS

A. The General Conditions of the Contract and Supplementary Conditions of the General Contract apply to work under this Division.

1.02 QUALITY ASSURANCE

A. The mechanical design for this project is based on specific manufacturers and equipment as scheduled on the drawings and listed in these Division Specifications with specific model number identifiers. Acceptable substitute manufacturers of equipment are listed in these specifications. If any acceptable substitute manufacturer's equipment is used, the cost of any change in design or construction required by their use shall be borne by the contractor. Contractor shall document and submit all changes to design plans and schedules as a result of the use of substituted equipment.

B. If manufacturer's material or equipment is listed in Schedules or on Drawings, they are types to be provided for establishment of size, capacity, grade, and quality. If other acceptable manufacturers are used, cost of any change in construction required by their use shall be borne by Contractor.

C. Equipment shall conform to State and/or local Energy Conservation Standards.

D. Execute and test all work per Underwriters, state and local codes, rules, and regulations applicable to trade affected. Included are recommendations of NFPA, SMACNA, OSHA, and ASHRAE. References to standards are latest revision of standard specified.

E. Comply with rules and regulations of local utility companies. Include cost of valves, valve boxes, meter boxes, meters, accessory equipment required for project.

1.03 INTENT AND INTERPRETATIONS

A. It is the intent of these Drawings and Specifications to result in a complete mechanical installation in complete accordance with all applicable codes and ordinances.

B. Drawings are diagrammatic in character and do not necessarily indicate every required pipe, offset, transition, etc. Items not specifically mentioned in the Specification or noted on the Drawings, but which are obviously necessary to make a complete working installation, shall be included.

C. Drawings and specifications are complementary. Whatever is called for in either is binding as though called for in both. The more stringent requirements shall govern.

D. Drawings shall not be scaled for rough-in measurements or used as shop drawings. Where drawings are required for these purposes or have to be made from field measurements, take the necessary measurements and prepare the drawings.

E. Symbols used on the Drawings are defined in the Legend on the Drawings. All symbols indicated on the Legend may not necessarily be required for the project.

F. “Provide” shall mean “furnish and install.” “Accepted” or “acceptable” denotes the work or equipment item is in conformance with the design concept of the project and, in general, complies with the pertinent information given in the Contract Documents.

G. Prior to ordering equipment, determine that equipment will adequately pass through building openings and passageways providing unobstructed access to final equipment location. Equipment shall be manufactured and shipped in sections for assembly in final equipment location when inadequate building openings and passageways limit access. Shop drawings and submittals shall indicate sectionalized manufacturing of equipment.

H. Before any work is installed, determine equipment will properly fit the space, required clearances can be maintained and equipment can be located without interferences between systems, with structural elements, or with the work of other trades.

I. If conflicts are discovered in Contract Documents as work progresses, submit a set of drawings marked with red pencil showing recommended modifications to the Architect for approval prior to installation.

J. The Drawings indicate the general arrangement of mechanical systems. However, rearrangement will not be permitted without specific approval prior to installation.

K. Provide incidental equipment such as tools, scaffolding, consumable items, testing equipment, appliances and the like whether listed or not. Provide labor, fees, licenses, start-up and checkout services also.

L. In the event that any discrepancies of any kind exist or required items or details have been omitted, notify the Architect in writing of such discrepancy or omission at least five days prior to bid date. Failure to do so shall be construed as willingness to supply all necessary materials and labor required for the proper completion of this work.

1.04 JOB CONDITIONS

A. Location, size, and type of equipment and material shown as existing are taken from existing drawings. Verify exact conditions in field prior to start of construction.

B. Before submitting bid, examine premises and become familiar with all existing conditions which may affect cost. No allowance will subsequently be made for not following this procedure.

C. Not all piping and ductwork offsets, transitions, and multiple connections required to install the new work into the available space are shown on the drawings. Field measure for exact requirements and install accordingly.

D. Confer, cooperate, and coordinate work with other trades. Coordinate ceiling cavity space carefully with all trades. In event of conflict, install mechanical and electrical systems within cavity space in following order of priority.
   1. Plumbing waste and vent piping.
   2. Roof drain piping.
   3. Ductwork.
   4. Electrical conduit and lighting.
   5. Hydronic piping
   6. Domestic hot and cold water piping.
   7. Fire sprinkler piping.

E. Where locations of devices and equipment are not specifically mentioned in the Specifications or indicated on the Drawings, verify locations with Architect or Owner prior to rough-in.

F. Submit large scale coordinated composite layouts showing both plan and elevation, piping, ducts, and conduits in areas that appear congested. Check routing of work prior to fabrication. Report conflicts to Architect.

G. Provide carpentry, masonry, concrete and metal work required for work of this Division where not specifically called for under other Sections.

1.05 PERMITS AND FEES

A. Arrange and pay for all inspections, permits, licenses, certificates, and fees required in connection with work.

1.06 SUBMITTALS AND SHOP DRAWINGS

A. Conform to requirements of Division 01 and following paragraphs.

B. All electronic submittal data shall be provided in separate Portable Document Format (pdf) folders for each individual Division specification section.

1.07 SUBSTITUTIONS

A. Equipment scheduled on drawings and specifically called for in these specifications was used as the basis of the mechanical systems design; modifications to the systems design to accommodate a substituted piece of equipment shall be the responsibility of the installing Contractor.

B. Coordinate all substituted equipment requirements with other trades prior to ordering equipment.

1.08 RECORD DOCUMENTS

A. Keep in custody during entire period of construction, a current set of documents indication changes that have been made to the Contract Documents. Changes to be noted on the documents shall include but shall not be limited to piping or ductwork installed more than 2'-0" from where shown on Drawings, changes in pipe and duct size, location of valves and cleanouts. Mark valve tag numbers on Drawings. Incorporate Addenda, accepted Alternates, Change Orders, and other Document revisions which occurred after the award of the General Contract or the start of construction activities into the Record Documents. Notations and changes shall be done in a neat and legible manner in accordance with Architect's instructions. Changes shall be noted in red, deletions in green, and notes in blue.

B. Upon completion of work, submit the complete set of Record Documents to the Architect. The Contract Documents set the standard for content and methods of presentation for the changes shown.

C. The Contract shall not be considered completed until these Record Documents have been reviewed and accepted by the Architect.

1.09 DELIVERY, STORAGE, HANDLING

A. Provide delivery and safe storage of materials and equipment. Make provisions for introduction into building of equipment too large to pass through finished openings. Provide for hoisting of equipment.

1.10 PROTECTION OF EQUIPMENT

A. Protect materials and equipment from physical damage, construction dirt, and the elements from time of shipment to time installation is accepted by Owner.

B. Protect work against theft, injury, or damage from all causes.

1.11 GUARANTEE

A. Reference "General Conditions" for warranty periods and conditions except for special conditions and warranties, whic shall be identified and listed within the appropriate individual sections.

PART 2 PRODUCTS

2.01 NOT USED

PART 3 EXECUTION

3.01 HANDLING OF EQUIPMENT USING REFRIGERANTS

A. Technicians handling equipment with refrigerants, for removal or installation, shall be EPA (Environmental Protection Agency) certified in accordance with Regulation No. 15 of Colorado Air Quality Control Commission, Section 608 of the Clean Air Act, 1990, as amended.

B. Type of technician certification shall be compatible with the handled equipment: high, very high, or low pressure appliances.

C. Evacuated refrigerant shall be recovered and recycled in accordance with EPA's requirements at the Contractor's expense.

D. Prior to handling of equipment with refrigerants, submit proof of technical and refrigerant handling equipment certification. After handling of refrigerants, submit detailed documentation, including type of refrigerant and quantities, indicating the steps taken to comply with EPA regulations.

3.02 EQUIPMENT WIRING AND CONNECTIONS

A. Voltage characteristics shall be as in Electrical Division of Specifications and on Electrical Drawings.

3.03 TEMPORARY FACILITIES

A. Light, Heat, Power, Etc.: Provide temporary power supply or other facilities required for Work. Arrange with proper parties to bring facilities from services to required location on premises.

B. Use of Existing Equipment for Temporary Heating or Cooling: Do not use building equipment without written permission from Owner. If building equipment is used for temporary heating or cooling, it shall be adequately maintained per manufacturer's instructions and protected with filters, strainers, controls, reliefs, etc. Guarantee period shall not start until equipment is accepted by Owner.

3.04 INSPECTIONS

A. Do not cover up or enclose work until inspected, tested, and approved. Any work enclosed or covered up before such approval shall be uncovered, tested, and approved.

3.05 ACCESS DOORS

A. Furnish hinged steel access doors with concealed latch, whether shown or not, in walls and plaster or gypsum board ceilings for access to concealed valves, air vents, motors, fans, balancing valves, or other operating devices requiring adjustment or servicing.

B. Access door shall be size of equipment to be removed or 24” by 24” if used for service only.

C. Furnish doors to trades performing work in which they are to be installed. Group valves, devices, and other equipment, to permit use of minimum number of access doors.

D. Doors shall be type compatible with finish in which they are to be installed.

3.06 SUPERVISION

A. Supervise work to proceed in proper sequence without delay to other contractors. Keep supervisor on premises at all times to ensure intent of Drawings and Specifications is being followed.

3.07 INSTALLATION

A. Workmanship shall be first quality. Appearance of work shall be of equal importance to its mechanical operation. Lack of quality workmanship shall be reason for rejection of system in part or in whole.

B. Install so all valves and equipment can be easily accessed and serviced by adequate clearance, (Per ASHRAE, manufacturers clearance requirements, or International Mechanical Code) installation of access doors, unions in piping, or other methods.

C. Complete installation shall function smoothly and noiselessly.

D. Install equipment and materials per manufacturers' recommendations and local codes or regulations.

E. Flush pipes free of foreign substances before installing valves or making final connections. Notify the Owner 7 days in advance of final flushing so the Owner can verify the cleanliness of the pipe. Clean all piping and equipment.

3.08 LUBRICATION OF EQUIPMENT

A. Lubricate equipment before operation and before turning over to Owner.

3.09 TESTING

A. All tests specified herein and/or called for by authorities having jurisdiction shall be witnessed by Architect or Owner. Reference other Division Sections for additional requirements specific to those sections.

B. Upon completion of the work, deliver certificates of inspection and final approval to Owner.

3.10 COMPLETION

A. Replace air filters if units were operated during construction. Clean ducts, blowers, and coils if units were operated without filters during construction.

B. Instruct Owner in operation and maintenance of mechanical systems. Minimum participants shall include mechanical contractor and controls contractor representatives.

C. After tests and adjustments have been made and systems pronounced satisfactory for permanent operation, refinish damaged finish and leave everything in proper working order and appearance.

D. On completion of work, remove tools, scaffolding, debris, etc., from grounds and leave premises clean.

3.11 PROJECT CLOSE-OUT

A. Upon written notice from the Contractor certifying the work is complete and ready for inspection, Engineer will prepare punchlist of items determined to be incomplete or otherwise not in compliance with intent of Contract Documents.

B. When required, subsequent visit to review completion of punchlist work will be made after receipt of written statement from Contractor indicating punchlist work is complete. Include copies of intermediate observation reports and final punchlists with individual items initialed by Contractor to attest that individual work items are completed.

C. Contractor shall pay Engineer's costs at the billing rates in effect at the time the services are performed for subsequent punch list visits required due to lack of completion of initial punch list.

3.12 OPERATION AND MAINTENANCE MANUALS

A. Prior to completion of project, submit three (3) sets of maintenance manuals covering operation and maintenance of mechanical equipment with moving or movable parts. Instructions shall be in pamphlet or typewritten form in three ring binders. Instructions for each unit shall be indicated by separate tab.
   1. Maintenance manuals submitted in electronic form shall be provided in separate Portable Document Format (pdf) folders for each system or item of equipment installed.

B. Include test and balance report.

C. Include valve tag list.

D. Include name, address, telephone number of party to be contacted for 24-hour service for each item of equipment.

E. Include starting, stopping, lubrication, preventative maintenance schedule, and adjustment information for each piece of equipment.

F. Include guarantees and warranties of all equipment.

END OF SECTION

SECTION 230500
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. HVAC demolition.
   2. Equipment installation requirements common to equipment sections.
   3. Concrete bases.

1.03 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.04 COORDINATION

A. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

B. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 3 EXECUTION

2.01 HVAC DEMOLITION

A. Refer to Division 01 Section for cutting and patching and Division 02 Section for selective structure demolition for general demolition requirements and procedures.

B. Disconnect, demolish, and remove HVAC systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

2.02 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

2.03 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast in-Place Concrete."

END OF SECTION

SECTION 230513
COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. General construction and requirements.

B. Three phase electric motors.

1.02 RELATED REQUIREMENTS

A. Division for electrical characteristics and wiring connections.

B. Section - Enclosed Controllers for HVAC Equipment

1.03 REFERENCE STANDARDS

A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings; 2015.

B. IEEE 112 - IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; 2017.

C. NEMA MG 1 - Motors and Generators; 2018.

D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.05 WARRANTY

A. See Division 01 - Closeout Submittals for additional warranty requirements.

B. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Baldor Electric Company/ABB Group: www.baldor.com/#sle.

B. General Electric; www.gepowerconversion.com

C. Square D

D. Substitutions: Not permitted.

2.02 GENERAL CONSTRUCTION AND REQUIREMENTS

A. Electrical Service: Refer to Division for required electrical characteristics.

B. Electrical Service:
1. Motors 3/4 HP and Smaller: Single phase, 60 Hz.
2. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
3. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
4. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

C. Construction:
   1. Open drip-proof type except where specifically noted otherwise.
   2. Design for continuous operation in 104 degrees F environment.
   3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.

D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.

E. Wiring Terminations:
   1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
   2. For fractional horsepower motors where connection is made directly, provide threaded conduit connection in end frame.

F. Thermal Protection (single phase motors): Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

2.03 THREE PHASE POWER - SQUIRREL CAGE MOTORS

A. Starting Torque: Between 1 and 1-1/2 times full load torque.

B. Starting Current: Six times full load current.

C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.

D. Design, Construction, Testing, and Performance: Comply with NEMA MG 1 for Design B motors.

E. Insulation System: NEMA Class B or better.

F. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.

G. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.

H. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

I. Sound Power Levels: To NEMA MG 1.

J. Nominal Efficiency: As indicated at full load and rated voltage when tested in accordance with IEEE 112.

K. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Designed with critical vibration frequencies outside operating range of controller output.
   2. Temperature Rise: Matched to rating for Class B insulation.
   3. Insulation: Class H.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
   5. Bearing Protection: Provide shaft grounding ring for protection from harmful VFD magnetics and voltages

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.

C. Check line voltage and phase and ensure agreement with nameplate.

END OF SECTION

SECTION 230515
VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Variable-frequency motor controllers for low-voltage (600 V and less) AC motor applications.

B. Overcurrent protective devices for motor controllers, including overload relays.

1.02 RELATED REQUIREMENTS

A. Section 230529 - Hangers and Supports for HVAC Piping and Equipment.

B. Division 26; Grounding and Bonding for Electrical Systems

C. Division 26; Fuses

1.03 REFERENCE STANDARDS

A. IEC 60529 - Degrees of Protection Provided by Enclosures (IP Code); 2013 (Corrigendum 2019).

B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.

C. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts; 2000, with Errata (2008).

D. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices; 2017.

E. NEMA ICS 6 - Industrial Control and Systems: Enclosures; 1993 (Reaffirmed 2016).

F. NEMA ICS 7 - Standard for Industrial Control and Systems: Adjustable-Speed Drives; 2020.

G. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems; 2014.

H. NEMA ICS 7.2 - Application Guide for AC Adjustable Speed Drive Systems; 2015.

I. NEMA ICS 61800-2 - Adjustable Speed Electrical Power Drive Systems, Part 2: General Requirements-Rating Specifications for Low Voltage Adjustable Frequency AC Power Drive Systems; 2005.

J. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.

K. NEMA MG 1 - Motors and Generators; 2018.

L. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2017.

M. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

N. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

O. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.

P. UL 61800-5-1 - Standard for Adjustable Speed Electrical Power Drive Systems - Part 5-1: Safety Requirements – Electrical, Thermal, and Energy; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate work to provide motor controllers suitable for use with actual motors to be installed.

2. Coordinate work to provide controllers and associated wiring suitable for interface with control devices to be installed.
3. Coordinate arrangement with dimensions and clearance requirements of actual equipment to be installed.
4. Verify with manufacturer that conductor terminations are suitable for use with conductors to be installed.
5. Notify Architect of conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.05 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.

C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

D. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
1. Include contact information for entity providing contract maintenance and trouble call-back service.

E. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

F. Project Record Documents: Record actual installed locations of controllers and final equipment settings.
1. Include nameplate data of actual installed motors and associated overload relay selections and settings.

1.06 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Store in clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.08 FIELD CONDITIONS

A. Maintain field conditions within required service conditions during and after installation.

1.09 WARRANTY

A. See Division 01 for additional warranty requirements under closeout submittals

B. Provide minimum 18 month manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. ABB: www.abb.com/#sle.

B. Danfoss: www.danfoss.com/#sle.

C. Schneider Electric; Square D Products: www.se.com/#sle.

D. Yaskawa; www.yaskawa.com

E. Substitutions: Not Allowed

2.02 VARIABLE-FREQUENCY MOTOR CONTROLLERS

A. Provide variable-frequency motor control system consisting of required controller assemblies, operator interfaces, control power transformers, instrumentation and control wiring, sensors, accessories, system programming, etc. as necessary for complete operating system.

B. Provide products listed, classified, and labeled as suitable for purpose intended.

C. Controller Assemblies: Comply with NEMA ICS 7, NEMA ICS 7.1, and NEMA ICS 61800-2; list and label as complying with UL 61800-5-1 or UL 508A as applicable.

D. Provide controllers selected for actual installed motors and coupled mechanical loads in accordance with NEMA ICS 7.2, NEMA MG 1 Part 30, and recommendations of manufacturers of both controller and load, where not in conflict with specified requirements; considerations include, but are not limited to:
   1. Motor type (e.g., induction, reluctance, and permanent magnet); consider NEMA MG 1 design letter or inverter duty rating for induction motors.
   2. Motor load type (e.g., constant torque, variable torque, and constant horsepower); consider duty cycle, impact loads, and high inertia loads.
   3. Motor nameplate data.
   4. Requirements for speed control range, speed regulation, and braking.
   5. Motor suitability for bypass starting method, where applicable.

E. Devices on Load Side of Controller: Suitable for application across full controller output frequency range.

F. Operating Requirements:
   1. Input Voltage Tolerance: Plus/minus 10 percent of nominal.
   2. Input Frequency Tolerance: Plus/minus 5 percent of nominal.
   3. Efficiency: Minimum of 96 percent at full speed and load.
   4. Input Displacement Power Factor: Minimum of 0.96 throughout speed and load range.
   5. Overload Rating:
      a. Variable Torque Loads: Minimum of 110 percent of nominal for 60 seconds.
      b. Constant Torque Loads: Minimum of 150 percent of nominal for 60 seconds.

G. Power Conversion System: Microprocessor-based, pulse width modulation type consisting of rectifier/converter, DC bus/link, and inverter.
   1. Rectifier/Converter: Diode-based, 6-pulse type unless otherwise indicated.

H. Control System:
   1. Provide microprocessor-based control system for automatic control, monitoring, and protection of motors. Include sensors, wiring, and connections necessary for functions and status/alarm indications specified.
   2. Provide integral operator interface for controller programming, display of status/alarm indications, fault reset, and local control functions including motor run/stop, motor forward/reverse selection, motor speed increase/decrease, and local/remote control selection.
   3. Control Functions:

a. Control Method: Selectable vector and scalar/volts per hertz unless otherwise indicated.
    1) Scalar/Volts per Hertz Control: Provide IR compensation for improved low-speed torque.
    2) Vector Control: Provide selectable autotuning function.
b. Adjustable acceleration and deceleration time; linear and S-curve ramps; selectable coast to stop.
c. Selectable braking control; DC injection or flux braking.
d. Adjustable minimum/maximum speed limits.
e. Adjustable pulse width modulation switching carrier frequency.
f. Adjustable motor slip compensation.
g. Selectable autorestart after noncritical fault; programmable number of time delay between restart attempts.

4. Status Indications:
    a. Motor run/stop status.
    b. Motor forward/reverse status.
    c. Local/remote control status.
    d. Output voltage.
    e. Output current.
    f. Output frequency.
    g. DC bus voltage.
    h. Motor speed.
    i. Speed reference.
    j. Analog input/output values.
5. Protective Functions/Alarm Indications:
    a. Overcurrent.
    b. Motor overload.
    c. Undervoltage.
    d. Overvoltage.
    e. Controller overtemperature.
    f. Input/output phase loss.
    g. Output short circuit protection.
    h. Output ground fault protection.
6. Inputs:
    a. Digital Input(s): Three.
    b. Analog Input(s): Two.
7. Outputs:
8. Communications: Compatible with connected systems. Provide accessories necessary for proper interface.
    a. Ethernet Communications: Support for Modbus TCP protocol.
    b. Remote Monitoring Capabilities:
        1) Motor run/stop status.
        2) Hand-off-auto status.
        3) Fault information.
        4) Discrete input/output status.
        5) Analog input/output values.
    c. Remote Control Capabilities:
        1) Motor run/stop command.
        2) Speed adjustment.
        3) Fault reset.
9. Features:
    a. Password-protected security access.
    b. Event log.

I. Power Conditioning/Filtering:
1. Provide DC link choke or input/line reactor for each controller unless otherwise indicated or required.
2. Provide input surge protection.

3. Reactor Impedance: 3 percent, unless otherwise indicated or required.

J. Packaged Controllers: Controllers factory-mounted in separate enclosure with externally operable disconnect and specified accessories.
   1. Disconnects: Circuit breaker or disconnect switch type.
      a. Disconnect Switches: Fusible type or nonfusible type with separate input fuses.
      b. Provide externally operable handle with means for locking in OFF position. Provide safety interlock to prevent opening cover with disconnect in ON position with capability of overriding interlock for testing purposes.
      c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
   2. Provide door-mounted remote operator interface.

K. Service Conditions:
   1. Provide controllers and associated components suitable for operation under following service conditions without derating:
      a. Altitude: Less than 3,300 feet.
      b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
   2. Provide controllers and associated components suitable for operation at indicated ratings under service conditions at installed location.

L. Short Circuit Current Rating:
   1. Provide controllers with listed short circuit current rating not less than available fault current at installed location as indicated on drawings.
   2. Provide line/input reactors where specified by manufacturer for required short circuit current rating.
   3. Label equipment utilizing series ratings as required by NFPA 70.

M. Conductor Terminations: Suitable for use with conductors to be installed.

N. Enclosures:
   1. Comply with NEMA ICS 6.
   2. NEMA 250 Environment Type or Equivalent IEC 60529 Rating: Unless otherwise indicated, as specified for following installation locations:
   3. Finish: Manufacturer's standard unless otherwise indicated.
   4. Cooling: Forced air or natural convection as determined by manufacturer.

O. Interface with Other Work:
   1. Provide products compatible with other systems requiring interface with controllers.
   2. Interface with building automation system.
      a. Capable of remote monitoring and control of controllers.

2.03 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:
   1. Provide overload relays and, where applicable, associated current elements/heaters selected for actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
   2. Comply with NEMA ICS 2.
   3. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
   4. Trip-free operation.
   5. Visible trip indication.
   6. Resettable:
      a. Employ manual reset unless otherwise indicated.
      b. Do not employ automatic reset with two-wire control.

B. Fusible Disconnect Switches:

1. Description: Quick-make, quick-break, dead-front fusible switch units complying with NEMA KS 1, and listed and labeled as complying with UL 98; ratings, configurations, and features as indicated or as required.
2. Fuse Clips: As required to accept indicated fuses.
3. Provide externally operable handle with means for locking in OFF position. Provide means for locking switch cover in closed position. Provide safety interlock to prevent opening of cover with switch in ON position with capability of overriding interlock for testing purposes.

2.04 ACCESSORIES

A. Auxiliary Contacts:
1. Comply with NEMA ICS 5.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each bypass motor starter, minimum.

B. Pilot Devices:
1. Comply with NEMA ICS 5; heavy-duty type.
2. Pushbuttons: Unless otherwise indicated, provide momentary, nonilluminated type with flush button operator; normally open or normally closed as indicated or as required.
3. Selector Switches: Unless otherwise indicated, provide maintained, nonilluminated type with knob operator; number of switch positions as indicated or as required.
4. Indicating Lights: Push-to-test type unless otherwise indicated.
5. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:
1. Comply with NEMA ICS 5.
2. Provide number and type of relays indicated or required to perform necessary functions.
3. Timing Relays: Electronic.

2.05 SOURCE QUALITY CONTROL

A. Factory test controllers in accordance with NEMA ICS 61800-2.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that ratings of controllers are consistent with indicated requirements.

C. Verify that mounting surfaces are ready to accept controllers.

D. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.

C. Do not exceed manufacturer's recommended maximum cable length between controller and motor.

D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.

E. Provide required support and attachment in accordance with Section 230529.

F. Install controllers plumb and level.

G. Provide grounding and bonding in accordance with Divsion 26.

H. Install field-installed devices, components, and accessories.

I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

J. Set field-adjustable settings of controllers and associated components according to installed motor requirements, in accordance with recommendations of manufacturers of controller and load.

3.03 FIELD QUALITY CONTROL

A. Inspect and test in accordance with NETA ATS, except Section 4.

B. Perform inspections and tests listed in NETA ATS, Section 7.17. Insulation-resistance test on control wiring listed as optional is not required.

C. Fusible Switches: Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.

D. Correct deficiencies and replace damaged or defective controllers or associated components.

3.04 ADJUSTING

A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05 CLEANING

A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.

B. Repair scratched or marred exterior surfaces to match original factory finish.

3.06 CLOSEOUT ACTIVITIES

A. See Division 01 - Closeout Submittals, for closeout submittals.

B. See Division 01 - Demonstration and Training, for additional requirements.

C. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.

D. Training: Train Owner's personnel on operation, adjustment, and maintenance of controllers and associated devices.
   1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
   2. Provide minimum of two hours of training.
   3. Instructor: Manufacturer's authorized representative.
   4. Location: At project site.

3.07 PROTECTION

A. Protect installed controllers from subsequent construction operations.

END OF SECTION

SECTION 230519
METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Test Plugs.

B. Pressure gauges and pressure gauge taps.

C. Thermometers and thermometer wells.

1.02 REFERENCE STANDARDS

A. ASME B40.100 - Pressure Gauges and Gauge Attachments; 2013.

B. ASTM E1 - Standard Specification for ASTM Liquid-in-Glass Thermometers; 2014.

C. ASTM E77 - Standard Test Method for Inspection and Verification of Thermometers; 2014 (Reapproved 2021).

D. UL 393 - Indicating Pressure Gauges for Fire-Protection Service; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide list that indicates use, operating range, total range and location for manufactured components.

C. Project Record Documents: Record actual locations of components and instrumentation.

PART 2 PRODUCTS

2.01 PRESSURE GAUGES

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.; www.ashcroft-gauges.com
3. Trerice, H. O. Co.; www.therice.com
4. Substitutions: See Division 01 for product requirements.

B. Pressure Gauges: ASME B40.100, UL 393 drawn steel case, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background.
1. Case: Steel with brass bourdon tube.
2. Size: 4-1/2 inch diameter.
3. Mid-Scale Accuracy: One percent.
4. Scale: Psi.

2.02 PRESSURE GAUGE TAPPINGS

A. Gauge Cock: Tee or lever handle, brass for maximum 150 psi.

2.03 STEM TYPE THERMOMETERS

A. Manufacturers:
1. Dwyer Instruments, Inc: www.dwyer-inst.com/#sle.
2. Ashcroft Commercial Instrument Operations Dresser Industries; Instrument Div.; www.ashcroft-gauges.com

3. Trerice, H. O. Co.; www.trerice.com

B. Thermometers - Adjustable Angle: Red- or blue-appearing non-toxic liquid in glass; ASTM E1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
   1. Size: 9 inch scale.
   2. Window: Clear Lexan.
   3. Stem: 3/4 inch NPT brass.
   4. Accuracy: 2 percent, per ASTM E77.
   5. Calibration: Degrees F.

2.04 THERMOMETER SUPPORTS

A. Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.

2.05 TEST PLUGS

A. Test Plug: 1/4 inch or 1/2 inch brass fitting and cap for receiving 1/8 inch outside diameter pressure or temperature probe with neoprene core for temperatures up to 200 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide one pressure gauge per pump, installing taps before strainers and on suction and discharge of pump. Pipe to gauge.

C. Install pressure gauges with pulsation dampers. Provide gauge cock to isolate each gauge. Extend nipples and siphons to allow clearance from insulation.

D. Install thermometers in piping systems in sockets in short couplings. Enlarge pipes smaller than 2-1/2 inch for installation of thermometer sockets. Ensure sockets allow clearance from insulation.

E. Locate test plugs adjacent thermometers and thermometer sockets.

3.02 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

3.03 SCHEDULE

A. Pressure Gauges, Location and Scale Range:
   1. Pumps, 0 to 100 psi.

B. Pressure Gauge Tappings, Location:
   1. Boiler - inlets and outlets.

C. Stem Type Thermometers, Location and Scale Range:
   1. Boilers - inlets and outlets, 0 to 180 degrees F.

END OF SECTION

SECTION 230523
GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Ball valves.

B. Butterfly valves.

C. Check valves.

1.02 RELATED REQUIREMENTS

A. Section 230719 - HVAC Piping Insulation.

B. Section 232113 - Hydronic Piping.

1.03 REFERENCE STANDARDS

A. API STD 594 - Check Valves: Flanged, Lug Wafer, and Butt-Welding; 2017.

B. ASME B1.20.1 - Pipe Threads, General Purpose (Inch); 2013 (Reaffirmed 2018).

C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250; 2020.

D. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

E. ASME B31.9 - Building Services Piping; 2020.

F. ASTM A126 - Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings; 2004 (Reapproved 2019).

G. MSS SP-67 - Butterfly Valves; 2017.

H. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends; 2010.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide data on valves including manufacturers catalog information. Submit performance ratings, rough-in details, weights, support requirements, and piping connections.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts listings.

1.05 QUALITY ASSURANCE

A. Manufacturer:
   1. Obtain valves for each valve type from single manufacturer.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Use the following precautions during storage:
   1. Maintain valve end protection and protect flanges and specialties from dirt.
      a. Provide temporary inlet and outlet caps.
      b. Maintain caps in place until installation.
   2. Store valves in shipping containers and maintain in place until installation.
      a. Store valves indoors in dry environment.
      b. Store valves off the ground in watertight enclosures when indoor storage is not an option.

B. Exercise the following precautions for handling:
   1. Handle large valves with sling, modified to avoid damage to exposed parts.
   2. Avoid the use of operating handles or stems as rigging or lifting points.

PART 2 PRODUCTS

2.01 APPLICATIONS

A. Listed pipe sizes shown using nominal pipe sizes (NPS) and nominal diameter (DN).

B. Provide the following valves for the applications if not indicated on drawings:
   1. Throttling (Hydronic): Butterfly and Ball.
   2. Throttling (Steam): Butterfly.
   3. Isolation (Shutoff): Butterfly and Ball.
   4. Swing Check (Pump Outlet):
      a. Size 2 inch and Smaller: Bronze with bronze disc.
      b. 2-1/2 NPS and Larger: Iron with lever and weight.

C. Heating Hot Water Valves:
   1. 2 NPS and Smaller, Bronze Valves:
      a. Threaded ends.
      b. Angle: Bronze disc, Class 125.
      c. Ball: Full port, two piece, stainless steel trim.
      d. Swing Check: Bronze disc, Class 125.
   2. Size 2-1/2 inch and Larger, Iron Valves:

2.02 GENERAL REQUIREMENTS

A. Valve Pressure and Temperature Ratings: No less than rating indicated; as required for system pressures and temperatures.

B. Valve Sizes: Match upstream piping unless otherwise indicated.

C. Valve Actuator Types:
   1. Hand Lever: Quarter-turn valves 6 NPS and smaller.

D. Valve-End Connections:
   1. Threaded End Valves: ASME B1.20.1.
   2. Flanges on Iron Valves: ASME B16.1 for flanges on iron valves.
   3. Solder Joint Connections: ASME B16.18.

E. General ASME Compliance:
   1. Building Services Piping Valves: ASME B31.9.

2.03 VALVE MANUFACTURERS

A. Ball Valves
   1. Apollo Valves; Manufactured by convraco Model 77-140 or 77-240; www.apollovalves.com.

B. Butterfly Valves
   1. Keystone by Emerson Model 362

C. Check Valves
   1. Apollo Valves: www.apollovalves.com/#sle.
   2. Crane Co.: www.cranevalve.com.

2.04 BRONZE, BALL VALVES

A. General:
   1. Fabricate from dezincification resistant material.
   2. Copper alloys containing more than 15 percent zinc are not permitted.

B. Two Piece, Full Port with Bronze or Brass Trim:
   1. Comply with MSS SP-110.
   2. WSP Rating: 150 psi.
   3. WOG Rating: 400 psi.
   4. Body: Forged bronze.
   5. End Connections: Pipe thread or solder.
   6. Seats: PTFE.
   7. Stem: Stainless steel.
   8. Ball: Stainless steel, vented.

2.05 IRON, SINGLE FLANGE BUTTERFLY VALVES

A. Lug Style; Bidirectional dead-end service without use of downstream flange:
   1. Comply with MSS SP-67, Type I.
   2. Lug Style, CWP Ratings:
      a. Sizes 2 to 12 inch: 150 psi.
      b. Sizes 14 to 24 inch: 100 psi.
      c. Vacuum Service: Down to 29.9 in-Hg.
   3. Body Material: ASTM A536 ductile iron.
   4. Stem: One or two-piece stainless steel.
   5. Seat: NBR.
   6. Disc: PTFE or TFE.

2.06 IRON, FLANGED END SWING CHECK VALVES

A. Class 125:
   1. 150 psi with metal seats.
   2. 200 psi with metal seats and nonmetallic-to-metal seats.

2.07 IRON, PLATE-TYPE CHECK VALVES

A. Class 125 Single-Plate:
   1. Comply with API STD 594.
   2. Sizes 2-1/2 to 12 inch: CWP Rating; 200 psi.
   3. Body Design: Wafer, spring-loaded plate.
   4. Body Material: ASTM A126, gray iron.
   5. Resilient Seat: EPDM or NBR.

PART 3 EXECUTION

3.01 EXAMINATION

A. Discard all packing materials and verify that valve interior, including threads and flanges, are completely clean without signs of damage or degradation that could result in leakage.

B. Verify valve parts to be fully operational in all positions from closed to fully open.

C. Confirm gasket material to be suitable for the service, to be of correct size, and without defects that could compromise effectiveness.

D. Should valve is determined to be defective, replace with new valve.

3.02 INSTALLATION

A. Provide unions or flanges with valves to facilitate equipment removal and maintenance while maintaining system operation and full accessibility for servicing.

B. Provide separate valve support as required and locate valve with stem at or above center of piping, maintaining unimpeded stem movement.

C. Install check valves where necessary to maintain direction of flow as follows:

1. Lift Check: Install with stem plumb and vertical.
2. Swing Check: Install horizontal maintaining hinge pin level.

END OF SECTION

SECTION 230529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Support and attachment components.

1.02 REFERENCE STANDARDS

A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.

B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.

C. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2014 (Reapproved 2020).

D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

E. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999, with Editorial Revision (2018).

F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.

G. ASTM A395/A395M - Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures; 1999 (Reapproved 2018).

H. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.

I. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

J. FM (AG) - FM Approval Guide; current edition.

K. MFMA-4 - Metal Framing Standards Publication; 2004.

L. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

M. UL (DIR) - Online Certifications Directory; Current Edition.

N. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. See Division 01 for submittal procedures

1.04 QUALITY ASSURANCE

A. Comply with applicable building code.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

A. General Requirements:

1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of plumbing work.
2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
4. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
    a. Indoor Dry Locations: Use zinc-plated steel unless otherwise indicated.
    b. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
    c. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.

B. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Manufacturers:
    a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com/#sle.
    b. Thomas & Betts Corporation: www.tnb.com/#sle.
    c. Unistrut, a brand of Atkore International Inc: www.unistrut.com/#sle.
    d. Source Limitations: Furnish hardware, fittings, and accessories from single manufacturer.
2. Provide factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
3. Comply with MFMA-4.
4. Channel Material:
5. Minimum Channel Thickness: Steel sheet, 12 gauge, 0.1046 inch.
6. Minimum Channel Dimensions: 1-1/2 inch width by 13/16 inch height.

C. Hanger Rods:
1. Threaded zinc-plated steel unless otherwise indicated.
2. Minimum Size, Unless Otherwise Indicated or Required:
    a. Piping up to 2 inch nominal: 3/8 inch diameter.
    b. Piping larger than 2 inch nominal: 1/2 inch diameter.
    c. Trapeze Support for Multiple Pipes: 3/8 inch diameter.
    d. Rod diameters may be reduced one size for double rod hanger sizes but no less than 3/8 inch..

D. Thermal Insulated Pipe Supports:
1. Manufacturers:
    a. Aeroflex USA, Inc: www.aeroflexusa.com/#sle.
    b. Buckaroos, Inc: www.buckaroos.com/#sle.
    c. KB Enterprises: www.snappitz.com/#sle.
2. General Requirements:
    a. Insulated pipe supports to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.
    b. Surface Burning Characteristics: Flame spread index/smoke developed index of 5/30, maximum, when tested in accordance with ASTM E84 or UL 723.
    c. Pipe supports to be provided for nominally sized, 1-1/4 inch to 12 inch iron pipes.
    d. Insulation inserts to consist of high density insulation surrounded by a 360 degree, PVC jacketing.

E. Pipe Supports:
1. Manufacturers:
    a. Anvil International, Inc.: www.anvilintl.com .

b. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
c. National Pipe Hanger Corporation: www.nationalpipehanger.com.

2. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.
3. Operating Temperatures from 101 through 210 degrees F:
   a. Overhead Support: MSS SP-58 Type 3 through 12 for piping 1-1/4 inch and smaller; Type 1 for piping larger than 1-1/4 inch, with appropriate saddle of MSS SP-58 Type 40 for insulated pipe.
   b. Roller Support: MSS SP-58 Types 41 or 43 through 46, with appropriate saddle of MSS SP-58 Type 39 for insulated pipe.
   c. Sliding Support: MSS SP-58 Types 35 through 38.

F. Beam Clamps:
1. MSS SP-58 types 19 through 23, 25 or 27 through 30 based on required load.
2. Beam C-Clamp: MSS SP-58 type 23, malleable iron and steel with plain, stainless steel, and zinc finish.
3. Small or Junior Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish. For inverted usage provide manufacturer listed size(s).
4. Wide Mouth Beam Clamp: MSS SP-58 type 19, malleable iron with plain finish.
5. Centerload Beam Clamp with Extension Piece: MSS SP-58 type 30, malleable iron with plain finish.
6. FM (AG) and UL (DIR) Approved Beam Clamp: MSS SP-58 type 19, plain finish,
7. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.
8. Material: ASTM A395/A395M ductile iron, ASTM A36/A36M carbon steel, ASTM A47/A47M malleable iron, ASTM A181/A181M forged steel, or ASTM A283/A283M steel.

G. U-Bolts:
1. MSS SP-58 Type 24, carbon steel u-bolt for pipe support or anchoring.

H. Strut Clamps:
1. Pipe Clamp: Two-piece rigid, universal, or outer diameter type, carbon steel with epoxy copper or zinc finish.

I. Pipe Hangers:
1. Hangers:
   a. Provide hinged split ring and yoke roller hanger with epoxy copper or plain finish.
   b. Material: ASTM A47/A47M malleable iron or ASTM A36/A36M carbon steel.
   c. Provide hanger rod and nuts of the same type and material for a given pipe run.
   d. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

J. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

K. Pipe Shields for Insulated Piping:
1. General Construction and Requirements:
   a. Surface Burning Characteristics: Comply with ASTM E84 or UL 723.
   b. Shields Material: ASTM A527, Galvanized steel, 24 gauge for pipe sizes up to 1-1/4 inch, 20 gauge for pipe sizes larger than 1-1/4 inch.
   c. Maximum Insulated Pipe Outer Diameter: 12-5/8 inch.
   d. Minimum Service Temperature: Minus 40 degrees F.
   e. Maximum Service Temperature: 178 degrees F.
   f. Pipe shields to be provided at hanger, support, and guide locations on pipe requiring insulation or additional support.

L. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that field measurements are as indicated.

B. Verify that mounting surfaces are ready to receive support and attachment components.

C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.

C. Unless specifically indicated or approved by Architect, do not provide support from suspended ceiling support system or ceiling grid.

D. Unless specifically indicated or approved by Architect, do not provide support from roof deck.

E. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

F. Provide thermal insulated pipe supports complete with hangers and accessories. Install thermal insulated pipe supports during the installation of the piping system.

G. Secure fasteners according to manufacturer's recommended torque settings.

H. Remove temporary supports.

END OF SECTION

SECTION 230553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Nameplates.

B. Tags.

C. Pipe markers.

D. Ceiling tacks.

1.02 REFERENCE STANDARDS

A. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2017.

PART 2 PRODUCTS

2.01 IDENTIFICATION APPLICATIONS

A. Air Terminal Units: Nameplates

B. Heat Transfer Equipment: Nameplates.

C. Instrumentation: Nameplates

D. Piping: Pipe markers.

E. Pumps: Nameplates.

F. Tanks: Nameplates.

G. Thermostats: Labels

H. Valves: Tags and ceiling tacks where located above lay-in ceiling.

2.02 NAMEPLATES

A. Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive, mechanically fastened.

B. Terminology: Match schedules as closely as possible.

C. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

D. Letter Color: White.

E. Letter Height: 1/2 inch.

F. Background Color: Black.

G. Plastic: Comply with ASTM D709.

2.03 LABELS

A. Description: Self adheasive laminate plastic tape with pre-printed identification

B. Size: Minimum size of 3/8" by 1" or larger as required to identify equipment.

C. Color: White or clear with black letters.

2.04 TAGS

A. Metal Tags: Brass with stamped letters; tag size minimum 1-1/2 inch diameter with smooth edges.

2.05 PIPE MARKERS

A. Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure-sensitive adhesive backing and printed markings.

B. Color code as follows:
   1. Heating, Cooling, and Boiler Feedwater: Green with white letters.

2.06 CEILING TACKS

A. Description: Steel with 3/4 inch diameter color coded head.

2.07 LAY-IN CEILING LABELS.

A. Description: Self adheasive paper or laminate plastic tape. 3/4 inch wide and 1-1/2 inch long with pre-printed identification.

B. Label Information: Provide identification of equipment, valve, control device, or similar equipment above lay-in ceiling. Label shall include identification as noted on contract documents, or clear identification of unit above ceilng.

PART 3 EXECUTION

3.01 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02 INSTALLATION

A. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

B. Provide ceiling tacks or ceiling labels to locate vav boxes, control panels, valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

SECTION 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pre-Construction measurement and recording of existing air and hydronic systems

B. Testing, adjustment, and balancing of air systems.

C. Testing, adjustment, and balancing of hydronic and refrigerating systems.

D. Commissioning activities.

1.02 RELATED REQUIREMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Division 01 for inspection and testing allowances.

C. Section 230800 - Commissioning of HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008, with Errata (2019).

B. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Installer Qualifications: Submit name of adjusting and balancing agency and TAB supervisor for approval within 30 days after award of Contract.

C. Pre-Construction TAB Report: Provide pre-construction measurements of existing air and hydronic systems as outlined below. Submit written report and retain for reference during post constuction activities.
   1. Submit under provisions of Division 01.
   2. Pre-construction TAB shall include measurement of all air and hydronic systems within the project scope of work.
   3. Air Handling Equipment:
      a. Total supply airflow
      b. Total return airflow
      c. Total outside air airflow
      d. Supply fan external static pressure
      e. Heating coil flow rate

D. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
   1. Include at least the following in the plan:
      a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
      b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
      c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
      d. Final test report forms to be used.

e. Procedures for formal deficiency reports, including scope, frequency and distribution.

E. Final Report: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1. Revise TAB plan to reflect actual procedures and submit as part of final report.
2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Architect and for inclusion in operating and maintenance manuals.
3. Provide reports in electronics (PDF) format, complete with index page and indesing bookmarks with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
4. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
5. Form of Test Reports: Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
6. Units of Measure: Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

A. Perform total system balance in accordance with one of the following:

B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.

C. TAB Agency Qualifications:
1. Company specializing in the testing, adjusting, and balancing of systems specified in this section.

D. TAB Supervisor and Technician Qualifications: Certified by same organization as TAB agency.

3.02 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

D. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
1. Systems are started and operating in a safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Air coil fins are cleaned and combed.
8. Access doors are closed and duct end caps are in place.

9. Air outlets are installed and connected.
10. Duct system leakage is minimized.
11. Hydronic systems are flushed, filled, and vented.
12. Pumps are rotating correctly.
13. Proper strainer baskets are clean and in place.
14. Service and balance valves are open.

E. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

F. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
1. Require attendance by all installers whose work will be tested, adjusted, or balanced.

D. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

E. Provide additional balancing devices as required.

3.04 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.05 RECORDING AND ADJUSTING

A. Field Logs: Maintain written logs including:
1. Running log of events and issues.
2. Discrepancies, deficient or uncompleted work by others.
3. Contract interpretation requests.
4. Lists of completed tests.

B. Ensure recorded data represents actual measured or observed conditions.

C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

D. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

F. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

G. Check and adjust systems approximately six months after final acceptance and submit report.

3.06 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.

L. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

M. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

N. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
   1. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

O. Measure terminal outlets and inlets without making adjustments.
   1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

P. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

3.07 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

3.08 WATER SYSTEM PROCEDURE

A. Prepare schematic diagrams of systems' "as-built" piping layouts.

B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
   1. Open all manual valves for maximum flow.
   2. Check expansion tank liquid level.
   3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
   4. Check flow-control valves for specified sequence of operation and set at indicated flow.
   5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
   6. Set system controls so automatic valves are wide open to heat exchangers.
   7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
   8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

C. Adjust water systems to provide required or design quantities.

D. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.

E. Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

F. Effect system balance with automatic control valves fully open to heat transfer elements.

G. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

H. Where available pump capacity is less than total flow requirements or individual system parts, full flow in one part may be simulated by temporary restriction of flow to other parts.

I. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
   1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
   2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
   3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
   4. Report flow rates that are not within plus or minus 5 percent of design.

J. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
   1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
3. Record settings and mark balancing devices.

K. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

L. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.09 INSPECTIONS

A. Final Inspection:
1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to either 10 percent of the total measurements recorded, or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.10 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

3.11 COMMISSIONING

A. Perform prerequisites prior to starting commissioning activities.

B. Fill out Prefunctional Checklists for:
1. Air side systems.
2. Water side systems.

C. Furnish to the Commissioning Authority, upon request, any data gathered but not shown in the final TAB report.

D. Re-check minimum outdoor air intake flows and maximum and intermediate total airflow rates for 10 percent of the air handlers plus a random sample equivalent to 10 percent of the final TAB report data as directed by Commissioning Authority.
1. Original TAB agency shall execute the re-checks, witnessed by the Commissioning Authority.
2. Use the same test instruments as used in the original TAB work.
3. Failure of more than 10 percent of the re-checked items of a given system shall result in the rejection of the system TAB report; rebalance the system, provide a new system TAB report, and repeat random re-checks.
4. For purposes of re-check, failure is defined as follows:

a. Air Flow of Supply and Return: Deviation of more than 10 percent of instrument reading.
b. Minimum Outside Air Flow: Deviation of more than 20 percent of instrument reading; for inlet vane or VFD OSA compensation system using linear proportional control, deviation of more than 30 percent at intermediate supply flow.
c. Temperatures: Deviation of more than one degree F.
d. Air and Water Pressures: Deviation of more than 10 percent of full scale of test instrument reading.
e. Sound Pressures: Deviation of more than 3 decibels, with consideration for variations in background noise.

5. For purposes of re-check, a whole system is defined as one in which inaccuracies will have little or no impact on connected systems; for example, the air distribution system served by one air handler or the hydronic chilled water supply system served by a chiller or the condenser water system.

E. In the presence of the Commissioning Authority, verify that:
1. Final settings of all valves, splitters, dampers and other adjustment devices have been permanently marked.
2. The air system is being controlled to the lowest possible static pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from fan to diffuser having all balancing dampers wide open and that during full cooling of all terminal units taking off downstream of the static pressure sensor, the terminal unit on the critical leg has its damper 90 percent or more open.
3. The water system is being controlled to the lowest possible pressure while still meeting design loads, less diversity; this shall include a review of TAB methods, established control setpoints, and physical verification of at least one leg from the pump to the coil having all balancing valves wide open and that during full cooling the cooling coil valve of that leg is 90 percent or more open.

3.12 SCOPE

A. Test, adjust, and balance the following:
1. Plumbing Pumps.
2. HVAC Pumps.
3. Boilers.
4. Air Handling Units.
5. Air Terminal Units.
6. Air Inlets and Outlets.

3.13 MINIMUM DATA TO BE REPORTED

A. Electric Motors:
1. Manufacturer.
2. Model/Frame.
3. HP/BHP.
4. Phase, voltage, amperage; nameplate, actual, no load.
5. RPM.
6. Service factor.

B. Pumps:
1. Identification/number.
2. Manufacturer.
3. Size/model.
4. Impeller.
5. Service.
6. Design flow rate, pressure drop, BHP.
7. Actual flow rate, pressure drop, BHP.
8. Discharge pressure.

9. Suction pressure.
10. Total operating head pressure.
11. Shut off, discharge and suction pressures.
12. Shut off, total head pressure.

C. Heating Coils:
1. Identification/number.
2. Location.
3. Service.
4. Manufacturer.
5. Air flow, design and actual.
6. Water flow, design and actual.
7. Water pressure drop, design and actual.
8. Air pressure drop, design and actual.

D. Air Moving Equipment:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Arrangement/Class/Discharge.
6. Air flow, specified and actual.
7. Return air flow, specified and actual.
8. Outside air flow, specified and actual.
9. Total static pressure (total external), specified and actual.
10. Inlet pressure.
11. Discharge pressure.
12. Sheave Make/Size/Bore.
13. Number of Belts/Make/Size.
14. Fan RPM.

E. Exhaust Fans:
1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave Make/Size/Bore.
10. Number of Belts/Make/Size.
11. Fan RPM.

F. Air Monitoring Stations:
1. Identification/location.
2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.

G. Terminal Unit Data:
1. Manufacturer.
2. Type, constant, variable, single, dual duct.
3. Identification/number.

4. Location.
5. Model number.
6. Size.
7. Minimum static pressure.
8. Minimum design air flow.
9. Minimum actual air flow.
10. Maximum design air flow.
11. Maximum actual air flow.
12. Inlet static pressure.

H. Air Distribution Tests:
1. Air terminal number.
2. Room number/location.
3. Terminal type.
4. Terminal size.
5. Area factor.
6. Design velocity.
7. Design air flow.
8. Test (final) velocity.
9. Test (final) air flow.
10. Percent of design air flow.

END OF SECTION

SECTION 230713
DUCT INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Duct insulation.

B. Duct Liner.

1.02 RELATED REQUIREMENTS

A. Division 07 for firestopping.

B. Division 09 for painting insulation jackets.

C. Section 230553 - Identification for HVAC Piping and Equipment.

D. Section 233100 - HVAC Ducts and Casings: Glass fiber ducts.

1.03 REFERENCE STANDARDS

A. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2021.

B. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).

C. ASTM C916 - Standard Specification for Adhesives for Duct Thermal Insulation; 2020.

D. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

E. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts; 2016 (Reapproved 2021).

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

H. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015 (Reapproved 2021)e1.

I. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials; National Fire Protection Association; 2006.

J. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

K. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

B. Manufacturer's Instructions: Indicate installation procedures necessary to ensure acceptable workmanship and that installation standards will be achieved.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.06 FIELD CONDITIONS

A. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

B. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84 or UL 723.

2.02 GLASS FIBER, FLEXIBLE

A. Manufacturer:
1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com.
3. Owens Corning Corporation: www.ocbuildingspec.com.
4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: ASTM C553; flexible, noncombustible blanket.
1. 'K' value: 0.36 at 75 degrees F, when tested in accordance with ASTM C518.
2. Maximum Service Temperature: 250 degrees F.
3. Maximum Water Vapor Absorption: 5.0 percent by weight.

C. Vapor Barrier Jacket:
1. Kraft paper with glass fiber yarn and bonded to aluminized film.
2. Moisture Vapor Permeability: 0.02 perm inch, when tested in accordance with ASTM E96/E96M.
3. Secure with pressure sensitive tape.

D. Vapor Barrier Tape:
1. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

E. Tie Wire: Annealed steel, 16 gage, 0.0508 inch diameter.

2.03 DUCT LINER

A. Manufacturers:
1. Knauf Insulation: www.knaufinsulation.com.
2. Johns Manville: www.jm.com.
3. Owens Corning Corporation: www.ocbuildingspec.com.
4. CertainTeed Corporation: www.certainteed.com.

B. Insulation: Non-corrosive, incombustible glass fiber complying with ASTM C1071; flexible blanket; impregnated surface and edges coated with black composite.
1. Fungal Resistance: No growth when tested according to ASTM G21.
2. Substitutions: See Division 01 for product requirements.
3. Apparent Thermal Conductivity: Maximum of 0.31 at 75 degrees F.
4. Service Temperature: Up to 250 degrees F.
5. Rated Velocity on Coated Air Side for Air Erosion: 5,000 fpm, minimum.

C. Adhesive: Waterproof, fire-retardant type, ASTM C916.

D. Liner Fasteners: Galvanized steel, impact applied with integral head.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that ducts have been tested before applying insulation materials.

B. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Insulated ducts conveying air below ambient temperature:
   1. Provide insulation with vapor barrier jackets.
   2. Finish with tape and vapor barrier jacket.
   3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
   4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

C. Duct Liner Application:
   1. Adhere insulation with adhesive for 90 percent coverage.
   2. Secure insulation with mechanical liner fasteners. Refer to SMACNA (DCS) for spacing.
   3. Seal and smooth joints. Seal and coat transverse joints.
   4. Seal liner surface penetrations with adhesive.
   5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.03 SCHEDULES

A. Refer to insulation schedule on drawings

END OF SECTION

SECTION 230719
HVAC PIPING INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping insulation.

B. Jackets and accessories.

1.02 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping: Placement of hangers and hanger inserts.

1.03 REFERENCE STANDARDS

A. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021.

B. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus; 2019.

C. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement; 2007 (Reapproved 2013).

D. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement; 2007 (Reapproved 2013).

E. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation; 2019.

F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

G. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.

1.07 FIELD CONDITIONS

A. Maintain ambient conditions required by manufacturers of each product.

B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Surface Burning Characteristics: Flame spread index/Smoke developed index of 25/50, maximum, when tested in accordance with ASTM E84.

2.02 GLASS FIBER, RIGID

A. Manufacturers:
   1. CertainTeed Corporation: www.certainteed.com/#sle.
   2. Johns Manville Corporation: www.jm.com/#sle.
   3. Knauf Insulation: www.knaufinsulation.com/#sle.
   4. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
   5. Substitutions: Not permitted.

B. Insulation: ASTM C547; rigid molded, noncombustible.
   1. K Value: ASTM C177, 0.23 at 75 degrees F.
   2. Maximum Service Temperature: 850 degrees F.
   3. Maximum Moisture Absorption: 0.2 percent by volume.

C. Vapor Barrier Jacket: White kraft paper with glass fiber yarn, bonded to aluminized film; moisture vapor transmission when tested in accordance with ASTM E96/E96M of 0.02 perm-inches.

D. Tie Wire: 0.048 inch stainless steel with twisted ends on maximum 12 inch centers.

E. Vapor Barrier Lap Adhesive: Compatible with insulation.

F. Insulating Cement/Mastic: ASTM C195; hydraulic setting on mineral wool.

G. Indoor Vapor Barrier Finish:
   1. Vinyl emulsion type acrylic, compatible with insulation, white color.

H. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.

I. Insulating Cement: ASTM C449.

2.03 JACKETS

A. Aluminum Jacket:
   1. Comply with ASTM B209/B209M, Temper H14, minimum thickness of 0.016 inch with factory-applied polyethylene and kraft paper moisture barrier on the inside surface.

PART 3 EXECUTION

3.01 EXAMINATION

A. Test piping for design pressure, liquid tightness, and continuity prior to applying insulation materials.

B. Verify that surfaces are clean and dry, with foreign material removed.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NAIMA National Insulation Standards.

C. Exposed Piping: Locate insulation and cover seams in least visible locations.

D. For hot piping conveying fluids 140 degrees F or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

E. Glass Fiber Insulated Pipes Conveying Fluids Above Ambient Temperature:
   1. Provide standard jackets, with or without vapor barrier, factory-applied, or field-applied. Secure with self-sealing longitudinal laps and butt strips with pressure-sensitive adhesive. Secure with outward clinch expanding staples.
   2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

F. Inserts and Shields:
   1. Application: Piping 1-1/2 inches diameter or larger for inserts, shields for all piping 1/2 inches and larger
      a. Provide 180 degree inserts and sheilds for clevis hanger assemblies
      b. Provide 380 degree inserts and shields for trapeeze hanger assemblies.
   2. Insert location: Between support shield and piping and under the finish jacket.
   3. Insert Configuration: Minimum 6 inches long, of same thickness and contour as adjoining insulation; may be factory fabricated.
   4. Insert Material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.
   5. Insert Material (Snappitz): Polyisocyanurate inner core, PVC outer jacket, self-locking Shields not required.

G. Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations. Finish at supports, protrusions, and interruptions. At fire separations, refer to Division 07.

H. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints, and valves wiht insulation of like material and thickness as adjoining pipg, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.03 SCHEDULE

A. Refer to insulation schedule on drawings

END OF SECTION

SECTION 230913
INSTRUMENTATION AND CONTROL DEVICES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and the Supplementary Conditions and Division 01 and Division 23 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Low voltage control wiring and conduit.
   2. Preassembled control panels.
   3. Construction supervision.
   4. Demonstration and training.
   5. Warranty.

B. System shall be Direct Digital Control (DDC).

1.03 DEFFINITIONS

A. "Central Control Station" - District Building Automation Group office, 809 Quail Street, Building #4, Lakewood, Colorado 80215.

B. "Central DDC Panel" - Central Control Panel, one location in each School.

C. "Unit Control" - Control module located at a piece of operating equipment.

D. "Remote PC" - Temporary connection via laptop or portable personal computer.

E. "Security Office" - Building #1; 24 hour security office/Central DDC Panel or ethernet.

F. "District Building Automation Group" - 809 Quail Street, Building #4, Lakewood, Colorado 80215.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer specializing in control system installations.

B. The technicians working on the project shall have completed the following Johnson Controls Institute training courses: Metasys FEC Custom Programming (#4704), Metasys system extended architecture Advanced Engineering (#397), Metasys CCT Custom Programming (#4704)and Metasys Systems Extended Architecture Engineering and Setup (#391).

C. If a controls contractor other than Johnson Controls is used, contractor to integrate system contol with existing Metasys system.

D. Manufacturer Qualifications: Engage a firm experienced in Manufacturing control systems similar to those indicated for this Project and that have a record of successful in-service performance.

E. Startup Personnel Qualifications: Engage specially trained personnel in direct employ of manufacturer of primary temperature control system.

F. Comply with NFPA 90A.

G. Comply with NFPA 70.

1.05 SUBMITTALS

A. General: Submit each item in this article according to the conditions of the Contract and Division 01 Specification Sections.

B. A table of contents including:

1. Warranty letter including start date of warranty.
2. Shop drawings.
    a. Index sheet of the drawings.
    b. Legend including all symbols used on the control drawings.
    c. Plan view of the facility indicating major corridors and room locations including:
        1) Point to point wiring (abbreviated versions of the final asbuilt drawings specified above).
        2) Location of temperature control panels.
        3) Location of outdoor air temperature to be agreed upon by the Engineer of Record. One to be in outdoor air stream and another to be located on the North side of the building.
        4) Location of relay enclosures containing three or more relays.
        5) Location of controllers installed above ceilings.
    d. Control panels including layout of panel internal components and door components.
    e. System sequence of operation printed on the associated drawings. Use uppercase and lowercase fonts rather than all uppercase.
    f. Sources of electrical power for controllers and control panel. Include the power panel number and circuit breaker.
    g. Place a border around details, such as exhaust fans, cabinet heaters, motor starters, located on the control drawings.
3. Manufacturer's data:
    a. All submittals must be clear readable original catalog or manufacturers' data sheets.
    b. Submittal sheets containing multiple model numbers shall have the specific models clearly identified.
4. As-built Control Drawings maximum size 11" x 17" and files of those drawings on Compact disk in AutoCAD® format of the following:
    a. Point to point connection diagrams for wiring.
    b. The detailed sequence of operation.
    c. The bill of materials used on the project.
5. Installation and calibration instructions.
    a. Software programs and sequences written in the program language and in English.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Johnson Controls Inc., Milwaukee, WI.

B. ATS Controls, Cambridge ON, Canada

2.02 ACCEPTABLE INSTALLERS

A. Johnson Controls Inc.

10289 West Centennial Road

Littleton, Colorado 80127

PH: 303-932-3739

FAX: 303-979-6847

B. No second tier contracting is allowed.

2.03 SYSTEM REQUIREMENTS

A. Unless specified otherwise, provide fully proportional components.

B. Provide necessary relays and signal boosters to make system complete and operable as required by sequence of operation.

2.04 SENSORS

A. Electronic Sensors: Vibration and corrosion resistant; for wall, immersion, or duct mounting as required.
   1. Thermistor or Platinum Resistance Temperature Detectors, temperature sensors as follows:
      a. Accuracy: Plus or minus 1 deg F at calibration point.
      b. Wire: Twisted, shielded-pair cable.
      c. Averaging Elements in Ducts: Averaging elements are to have 1 foot linear for each 2 square feet of coil area. Multiple averaging elements may be used in conjunction to achieve this coverage; flexible; use where prone to temperature stratification or where ducts are larger than 9 sq. ft.; length as required. . Temperature range of 32 deg F to 110 Deg F, repeatable 1.5% of range.
      d. Insertion Elements for Liquids: Brass socket with minimum insertion length of 2-1/2 inches. . Temperature range of 35 deg F to 220 Deg F, repeatable within 1% of range.
      e. Room Sensors: Surface mounted with cover allowing air movement across the sensor. Temperature range of 50 deg F to 95 Deg F, repeatable 1.5% of span.
      f. Outside-Air Sensors: Watertight inlet fitting, shielded from direct sunlight. . Temperature range of -20 deg F to 110 deg F, repeatable within 0.5 deg F.
   2. Aquastat: Provide strap on type.

B. Equipment operation sensors as follows:
   1. Status Inputs for Electric Motors including fans and pumps: Current-sensing relay with current transformers, adjustable. Approved products are: Hawkeye model 705, Kele & associates model SD150 and Veris Industries.
      a. Indication of contact status by use of an LED either changing color or rate of flashing.
      b. Pilot rated contacts.
      c. Adjustable set point.
      d. Install sensor on the power conductor for single phase motors or on L1 for three phase motors.
      e. Sensor Calibration:
         1) Fans and Pumps: Alarm activation setpoint is 80% of fully loaded current as measured during balancing operations. Set point for status is 80% of the final loaded amps after the TAB has completed their work. Each current sensor needs to be verified via a written report for the controls contractor.
         2) Document the calibrated setpoint on the control drawings.

2.05 THERMOSTATS

A. Low-Voltage, On-Off Thermostats: NEMA DC 3, 24-V, bimetal-operated, bellows actuated type, with adjustable or fixed anticipation heater.

B. Line-Voltage, On-Off Thermostats: Bimetal-actuated, open contact or bellows-actuated, enclosed, snap-switch type, or equivalent solid-state type, with heat anticipator, integral manual on-off-auto selector switch.
   1. Equip thermostats, which control electric heating loads directly, with off position on dial wired to break ungrounded conductors.
   2. Dead Band: Maximum 2 deg F.

C. Electric Low-Limit Duct Thermostat (Freeze Stats): Penn 70HA-1 (Manual Reset).
   1. Contacts are activated on temperature drop below an adjustable 15-55 Deg F set point.
   2. Quantity: One lineal foot of thermostat element for every 2 sq. ft. of coil surface.
   3. Contacts rated for line voltage, Two SPST sets, one opens and one closes upon temperature drop.
   4. Provide 120 VAC maximum through the normally closed set of thermostat contacts that de-energize the motor starter.
   5. Vapor filled type responsive only to the lowest temperature sensed along any one foot, maximum, length of the element.

6. Manual reset on air handling units containing water or glycol coils accessible without the aid of a ladder.

2.06 ACTUATORS

A. All damper and valve actuators shall be manufactured by Johnson Control Company.

B. Electric Motors: Size to operate with sufficient reserve power to provide smooth modulating action or two-position action.120/60/1 on large control valves (4" and larger line size). No double driving (two motors on a single shaft) of low voltage JCI standard actuators for these applications will be permitted.
   1. Comply with requirements in Division 23 Section "Motors."
   2. Permanent Split-Capacitor or Shaded-Pole Type: Gear trains completely oil immersed and sealed. Equip spring-return motors with integral spiral-spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
   3. Nonspring-Return Motors for Valves Larger Than 2-1/2-inch: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   4. Spring-Return Motors for Valves Larger Than 2-1/2-inch: Size for running and breakaway torque of 150 in. x lbf.
   5. Nonspring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running torque of 150 in. x lbf and breakaway torque of 300 in. x lbf.
   6. Spring-Return Motors for Dampers Larger Than 25 Sq. Ft.: Size for running and breakaway torque of 150 in. x lbf.

C. Electronic Damper and Valve Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
   1. Valves: Size for torque required for valve close-off at maximum pump differential pressure.
   2. Dampers: Size for running torque calculated as follows:
      a. Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. of damper.
      b. Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. of damper.
      c. Dampers with 2 to 3 Inches wg of Pressure Drop or Face Velocities of 1000 to 2500 FPM: Multiply the minimum full-stroke cycles above by 1.5.
      d. Dampers with 3 to 4 Inches wg of Pressure Drop or Face Velocities of 2500 to 3000 FPM: Multiply the minimum full-stroke cycles above by 2.0.
   3. Coupling: V-bolt and V-shaped, toothed cradle.
   4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
   5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
   6. Power Requirements (Two-Position Spring Return): 120-V ac.
   7. Power Requirements (Modulating): 120-V ac.
   8. Proportional Signal: 2- to 10-V dc or 4 to 20 mA, and 2- to 10-V dc position feedback signal.
   9. Temperature Rating: Minus 22 to plus 122 deg F.
   10. Run Time: 12 seconds open, 5 seconds closed.
   11. Modulating magnetic or electric actuators shall include integral over stroke protection.

2.07 CONTROL VALVES

A. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated.

B. Flanged cast iron in sizes 2½ inches and larger, otherwise bronze. Seat and inner valve material of hardened steel. Sizes 2 inches and smaller. single piece ball valve with union connections or threaded connections. No soldered connections.

C. Hydronic system valves shall have the following characteristics:
   1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
   2. Sizing: 5-psig maximum pressure drop at design flow rate.

3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics. Operators shall close valves against pump shutoff head.
4. All two way control valves serving air handling units shall be pressure independant 2-way control valves or 3-way ball type control valves. Refer to equipment schedules for unit valve types.

D. Unit Control Valves (Ball Valves): Brass body, chrome plated ball and trim, two- or three-port as indicated, PTFE seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 5-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
4. Use self contained remote bulb type valves for baseboard radiation that is not the primary source of heating.

E. Unit Control Valves (Globe Valves): Bronze body, bronze trim, two- or three-port as indicated, replaceable plugs and seats, union and threaded ends.
1. Rating: Class 125 for service at 125 psig and 250 deg F operating conditions.
2. Sizing: 5-psig maximum pressure drop at design flow rate, to close against pump shutoff head.
3. Flow Characteristics: Two-way valves shall have equal percentage characteristics; three-way valves shall have linear characteristics.
4. Use self contained remote bulb type valves for baseboard radiation that is not the primary source of heating.

F. Provide spring return actuators that return to the normal position in the absence of power (valves 2” and larger). Heating and combination heating/cooling valves NO, cooling Valves NC.

2.08 DAMPERS

A. Dampers: AMCA-rated, parallel-blade design; 0.1084-inch minimum, galvanized-steel frames with holes for duct mounting; damper blades shall not be less than 0.0635-inch galvanized steel with maximum blade width of 8 inches.
1. Blades shall be secured to 1/2-inch- diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. For standard applications, include optional closed-cell neoprene edging.
4. For low-leakage applications, use parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4 inches wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.09 OVERRIDE SWITCHES

A. Timed Override Switches: Provide toggle type (OFF/AUTO/ON) with four hour duration, software adjustable, and LED indicators that override the programmed sequence and permit selected equipment to operate in the occupied mode for intervals up to the limit of the timer. Locate the timers next to the central DDC controller, mounted in a single panel and labeled.

B. System override switch: Include a toggle switch in the controls of each air handling unit to place them in unoccupied mode during an unscheduled day off.

C. Function of this combination shall be as follows:
1. Normal Mode: Toggle is in the "AUTO" position. Unit is controlled throught the Metasys to the District schedule. LED is energized whenever the supply fan status has proof of operation and de-eneergized whenever the supply fan status indicates the fan is off.

2. Override Mode - ON: Toggle is switched to the “ON” position. If unit is off due to the District schedule, unit will start for a single, scheduled override period of 4 hours (software adjustable). LED is energized whenever the supply fan status has proof of operation and de-energized whenever the supply fan status indicated the fan is off. At the end of the scheduled override period the unit shall be controlled through the Metasys to the District schedule.
3. Override Mode - OFF: Toggle is switched to the “OFF” position. When toggle is switched to “OFF”, the unit will revert to the unoccupied cycle as defined below. LED is energized whenever the supply fan status has proof of operation and de-energized whenever the supply fan status indicates the fan is off

2.10 EPO SWITCHES

A. Break-glass type, emergency push button switch. Low voltage switch with red push-button in accessible enclosure. Switch shall be capable of low voltage relay to terminate power to boiler gas train valves and send 4-20ma signal to boiler management system.
1. Square D # KYK117 or equal.
2. Pilla ST120SN1-SL break glass to release button or equal.

2.11 WATER-FLOW SWITCHES:

A. Pressure-flow switches of bellows-actuated mercury or snap-acting type, with appropriate scale range and differential adjustment, with stainless-steel or bronze paddle. For chilled-water applications, provide vaporproof type.

2.12 MISCELLANEOUS DEVICES

A. Plastic laminate labels:
1. All control panels, junction boxes larger than 4-11/16” x 4-11/16” containing components, controller enclosures, and duct mounted sensors require screwed or riveted plastic laminate labels, no adhesives. Control valves and damper actuators do not require laminate labels.
2. Control panels shall have labels attached to the panel face and control components within the panel.
3. Do not attach labels to replaceable devices or sensors.
4. Junction boxes smaller than 4-11/16” x 4-11/16” and not containing relays or control devices do not require plastic laminate labels. These need to be identified using a permanent black ink marker with a “TC” on the cover.

B. 24V Control Power Transformer: Johnson Controls Model JM2211.

C. Control Relay load Control: Johnson Controls R1BU1C or PAM-1.

D. Shielded cable: Used on critical communication and sensor lines as recommended by the manufacturer or advised by the consulting engineer.

PART 3 - EXECUTION

3.01 GENERAL

A. The controls contractor shall be responsible for preassembly and installing panels and all hardware with his own employees, providing the system and training School District personnel in its proper function and maintenance.

B. Wiring, conduit placement, and the installing of actuators and related linkage may be subcontracted to a School District approved installer but controls contractor shall label and connect all wiring terminations and be responsible for the subcontractor's work.

3.02 DEMONSTRATION AND TRAINING

A. Instruct Owner's operating personnel in operation and maintenance of control system. Furnish three instruction manuals covering function, operation, maintenance of control components.

Furnish control system record drawings and sequence of operation to Owner and Mechanical Engineer for inclusion in O&M Manuals.

B. Prior to the Start of Training:
   1. All equipment will be operational and Accepted by Mechanical Engineer.
   2. O&M Manuals will be Complete

C. Training will be recorded and copied on a DVD.

3.03 WIRING

A. Plenum rated wire inside of plenums. Wiring suspended neatly from the overhead structure with bridle rings. Do not lay on top of ceiling tiles. Minimum wire size, 18 AWG stranded.

B. Reference DCAD drawing for wire support details.

C. Color code wiring terminals and provide a cross reference to the drawings to ease later check-out and diagnosis. Color coding is as follows:

Input/Output Point Type or Wire Type	Cable or Jacket Color
AI	Yellow
AO	Tan
DI	Orange
DO	Violet
N2 Bus	Blue, Yellow, Violet wires
24vac	Orange and Brown

D. Place exposed control wiring in conduit.

E. Nylon cable ties are to be secured with a tensioning tool designed for this purpose. Cutting the loose ends with diagonal or side cutters is not permitted.

F. Coordinate location of thermostats and other exposed control sensors with plans and room details before installation. Locate thermostats 60 inches above floor. Thermostats shall not be placed in direct sunlight or near any powered device as identified on architectural floor plans. Ideally a thermostat is located beneath a return or an exhaust grille.

G. Unless otherwise shown on electrical drawings, provide line voltage wiring for all new control panels and accessory equipment.

H. Installation of low voltage control wiring is the responsibility of the Contractor. The powering of control devices shall be the responsibility of the contractor.

I. Interlock alarms with starter switching to bypass alarm when equipment is manually disconnected.

J. Where controllers are relocated, wire nuts or splices shall not be utilized. New control wiring shall be provided to extend the controller to the new location.

K. Inactive and unused cables shall be removed from the plenum.

3.04 POST INSTALLATION INSPECTION AND REPORT

A. Upon completion of the temperature control installation, check system, including equipment, and certify to Engineer that system is performing as specified.

END OF SECTION

SECTION 230923
INTEGRATED AUTOMATION LOCAL CONTROL UNITS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and the Supplementary Conditions and Division 01 and Division 23 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Electronic analog or direct digital automatic temperature controllers for individual HVAC equipment.

PART 2 - PRODUCTS

2.01 GENERAL

A. Central DDC panel is existing.

B. Mount controllers, relays, switches, etc., for equipment in enclosed 12 gauge control panels with baked enamel finish, hinged locking doors. Mount control devices and indicators for equipment located in exposed areas subject to outside weather conditions inside weatherproof enclosures. Panel location shall be convenient for service. Provide nameplates beneath each panel-mounted control device describing function of device.

C. Prewire electrical devices within panel to terminal strips with inter-device wiring within panel completed prior to installation of system.

2.02 ALL INDIVIDUAL EQUIPMENT (APPLICATION SPECIFIC) CONTROLLERS

A. Function independently on loss of communications with the central DDC controller.

B. Capable of program changes or displaying data while in communication with:
   1. A portable computer plugged into the central DDC controller.
   2. A remote computer via ethernet through the central DDC controller.

C. Locally adjustable address, setpoints, and sensor scaling.

D. Control by proportional, integral, derivative, or combinations.

E. Proportional heating and cooling with adjustable deadband.

F. Either 0 or 10 VDC or 4 to 20 mA proportional output.

G. Internal switches (or software) for each output to change from direct to reverse acting.

2.03 MAJOR EQUIPMENT CONTROLLERS

A. Locally and centrally control each air handling unit, chiller and boiler, by a controller mounted on or near that piece of equipment.

B. Each electronic controller shall have the below listed data (as applicable) readable and commandable at the individual equipment controller with a plug-in computer, at the central DDC controller or from a remote computer via ethernet, as applicable. Design an EIA-252 communication bus so that the foregoing is possible. Percentage data readings must state percent open. (* = read only).
   1. Each air handling unit:
      a. Fan start/stop.
      b. Outside air damper percent open: Command only no feedback.
      c. Return air damper percent open: Command only no feedback.

d. Exhaust air damper percent open: Command only no feedback.
e. Heating coil valve percent open: Command only no feedback.
f. Evaporative Cooler pump start/stop.
g. Evaporative Cooler valve open/closed: Command only no feedback.
h. Return air temperature.
i. Discharge air temperature.
j. Mixed air temperature.
k. Smoke detector alarm *.
l. Freeze stat alarm *.
m. Supply fan status.
n. Supply airflow measurement.
o. Return fan status.
p. Return airflow measurement
q. Relief/Exhaust airflow measurement (may be calculated in controls logic from damper position).
r. Outside airflow measurement (may be calculated in controls logic from damper position).

2. Outside Air Temperature Roof (OA-T - TR) - Analog Input for outside air temperature roof. Locate in outdoor air side of Roof Top Unit.
3. Heating Water system:
   a. Each boiler enable/disable.
   b. Each boiler status on/off*.
   c. Boiler circ pumps start/stop.
   d. Boiler circ pumps status on/off*.
   e. Heating water pumps start/stop.
   f. Heating water pumps status on/off*.
   g. Heating water supply temperature.
   h. Heating water return temperature*.
   i. Heating water flow as measured downstream of pump discharge.
   j. Alarm status*.
4. Mode:
   a. Occupied.
   b. Unoccupied.
   c. Warmup*.

2.04 HEATING PLANT CONTROLLER

A. Use a major equipment controller reporting to the central DDC control panel to sequence the existing boilers and reset heating water temperature. Boiler manufacturer's control panels are not permitted.

B. Use the North outside air temperature sensor (OA-TN,in Heating/Chilled Water Plant Controller) to reset heating water temperature. The location of this sensor shall be identified on the as-built temperature control and construction drawings.

C. Follow the guidelines above for major equipment controllers.

2.05 INDIVIDUAL EQUIPMENT CONTROLLER SOFTWARE

A. Routinely report to the central DDC controller.

B. Continuously poll data for changes at minimum intervals of 100 milliseconds.

C. Continuously accumulate data pulses up to two per second.

D. Digital outputs in four forms: pulsed, sustained, pulse width modulated and binary staged closures.
   1. Pulsed closures: 200 milliseconds.
   2. Keep sustained closures in the commanded state until receipt of a contrary command.
   3. Vary pulse width modulation form 100 milliseconds to 255 seconds.
   4. Permit up to eight levels of staging.

PART 3 - EXECUTION

3.01 GENERAL

A. Locate each individual equipment controller near the equipment served and label its function.

B. Follow the accessibility requirements of 230913 “Instrumentation and Control Devices for HVAC”.

END OF SECTION

SECTION 230993
SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This section defines the manner and method by which controls function. Requirements for each type of control system operation are specified. Equipment, devices, and system components required for control systems are specified in other sections.

B. Sequence of operation for:
   1. Air terminal units.
   2. Air Handling units

1.02 RELATED REQUIREMENTS

A. Division 26 for electrical characteristics and wiring connections.

1.03 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Sequence of Operation Documentation: Submit written sequence of operation for entire HVAC system and each piece of equipment.
   1. Include at least the following sequences:
      a. Start-up.
      b. Warm-up mode.
      c. Normal operating mode.
      d. Unoccupied mode.
      e. Shutdown.
      f. Capacity control sequences and equipment staging.
      g. Temperature and pressure control, such as setbacks, setups, resets, etc.
      h. Detailed sequences for all control strategies, such as economizer control, optimum start/stop, staging, optimization, demand limiting, etc.
      i. Effects of power or equipment failure with all standby component functions.
      j. Sequences for all alarms and emergency shut downs.
      k. Seasonal operational differences and recommendations.
      l. Interactions and interlocks with other systems.
   2. Include initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   3. For packaged controlled equipment, include manufacturer's furnished sequence of operation amplified as required to describe the relationship between the packaged controls and the control system, indicating which points are adjustable control points and which points are only monitored.
   4. Include schedules, if known.

C. Control System Diagrams: Submit graphic schematic of the control system showing each control component and each component controlled, monitored, or enabled.
   1. Label with settings, adjustable range of control and limits.
   2. Include flow diagrams for each control system, graphically depicting control logic.
   3. Include the system and component layout of all equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
   4. Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.
   5. Include all monitoring, control and virtual points specified in elsewhere.
   6. Include a key to all abbreviations.

D. Points List: Submit list of all control points indicating at least the following for each point.
   1. Name of controlled system.
   2. Point abbreviation.
   3. Point description; such as dry bulb temperature, airflow, etc.
   4. Display unit.
   5. Control point or setpoint (Yes / No); i.e. a point that controls equipment and can have its setpoint changed.
   6. Monitoring point (Yes / No); i.e. a point that does not control or contribute to the control of equipment but is used for operation, maintenance, or performance verification.
   7. Intermediate point (Yes / No); i.e. a point whose value is used to make a calculation which then controls equipment, such as space temperatures that are averaged to a virtual point to control reset.
   8. Calculated point (Yes / No); i.e. a “virtual” point generated from calculations of other point values.

1.04 QUALITY ASSURANCE

A. Design system under direct supervision of a Professional Engineer experienced in design of this work and licensed at the State in which the Project is located.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 VAV AIR HANDLING UNIT SEQUENCE OF OPERATION

A. Description:
   1. The VAV air handling unit consists of the following system components:
      a. Variable volume supply air fan with VFD
      b. Unit relief/exhaust air fan with VFD
      c. Motorized return & outside air dampers
      d. Hot water heating coil
      e. DX cooling coil
      f. Outside airflow monitoring station
      g. Supply air CO detection
      h. Return air CO2 controls
      i. Duct static pressure controls

B. General:
   1. The Control Contractor shall also provide DDC VAV terminal unit controllers, sensors, and hot water coil valves for all scheduled VAV terminal units.
   2. The Control Contractor shall connect each controller to the communication network, bind all applicable points, and program each air handling unit controller in accordance with the following sequences.

C. System Control:
   1. Supply Fan Control: Modulate fan speed to maintain duct static pressure setpoint as outlined below. Fan static pressure setpoint shall be determined as pressure required to maintain 1-inch w.c.. at furthest box.
   2. Duct Static Pressure Control:
      a. The BMS shall measure duct static pressure and modulate the supply air fan VFD speed to maintain a duct static pressure setpoint. The speed shall not drop below 10% (adjustable). The static pressure setpoint shall be reset based on zone cooling/heating requirements.
      b. The BMS will modulate the supply air fan air volume to maintain supply air pressure setpoint. The BMS shall directly interface with the supply fan VFD. A duct static pressure sensor located in the supply air ductwork as indicated on the construction

drawings. The final location shall be proposed by the TC and submitted to the engineer for final approval.

c. The BMS monitors the damper position of all VAV terminal units to determine the critical zone (The VAV terminal unit that is the highest percentage open). The goal is to maintain duct static pressure as low as possible at all times. This is achieved by maintaining the critical zone between 85% and 95% open.
d. When the critical zone is more than 95% open, the supply fan discharge static pressure resets upward by 0.10" (adjustable), from the previous setpoint, at a frequency of 10 minutes until the critical zone is less than 95% open.
e. The control bands, setpoint increment values, setpoint decrement values, and adjustment frequencies will be adjusted to optimize static pressure control for stable system operation.
f. Design duct static pressure setpoint is 1.5". To satisfy all zones at all times higher setpoints may be calculated by this routine. These conditions which cause higher setpoints shall be investigated and resolved to allow the system to operate at lower pressures. A maximum setpoint will be set so that a trouble zone will not drive the setpoint beyond a reasonable value. Maximum allowed static pressure is 1.75" (adjustable)

3. Relief/Exhaust Fan Control: Modulate fan speed to maintain building static pressure of 0.05 in wc (adjustable). Building static pressure is measured from remote building differential pressure sensor as located on the mechanical drawings. Fan tracking shall not be included for building static pressure control.
4. Mixed-Air Control: Modulate OA and RA dampers to maintain minimum outside air setpoints as indicated on the equipment schedules in response to outside air airflow as measured from outside airflow monitoring station. CO2 may over-ride minimum airflow setpoints based on minimum/maximum CO2 levels.
5. Demand Controlled Ventilation (DCV): DCV is enabled and disabled through the BAS. Enable DCV function whenever system is in occupied mode. When the DCV system is enabled the minimum outside air damper position shall be reset between the minimum outside air floor and ceiling positions to maintain the return air CO2 setpoint. The minimum outside air ventilation ceiling value is based on ASHRAE 62.1 calculations incorporating floor area and fully occupied space ventilation requirements. The minimum outside air floor value is based on the ASHRAE 62.1 calculation incorporating floor area ventilation requirements. Outside airflow rates shall be as determined from unit OSA airflow monitoring station. Refer to equipment schedule for DCV minimum outside air value.
    a. Limit the maximum outside air damper position based on a mixed air temperature low limit of 45 degrees F. (adjustable). Economizer function overrides DCV functions. If CO2 levels exceed maximum CO2 level setpoints, system shall modulate OSA dampers open in 5% airflow increments at 10 minute intervals until CO2 levels drop below maximum setpoint.
6. CO2 Reset Mixing Dampers: The CO2 content in each classroom/office/space (as indicated on the construction drawings and its VAV damper position shall be monitored. As necessary, the air handling unit mixing dampers shall be overridden open, to additional outside air, so as to maintain CO2 levels in said space at required levels.
7. Economizer: When conditions are favorable (outside air is less than return air), modulate OA and RA dampers to maintain discharge air temperature. When mixed air temperature exceeds SA setpoint enable cooling in conjunction with economizer.
8. HW Heating Coil: Modulate hot water coil valve to maintain discharge air temperature setpoint.
9. DX Cooling Coil: Unit controls stage DX compressors, and [hot gas bypass][variable speed compressor] to maintain discharge air temperature setpoint.
10. Provide discharge air temperature reset based on average zones. Average demand to be determined by a polling of all zones by the BAS and deviation from setpoint.

D. Modes of Operation:
    1. The occupancy mode (occupied-unoccupied) shall be determined through a user-adjustable, graphical, seven-day schedule with an additional holiday schedule.

2. Occupied Mode:
    a. The supply fan shall run continuously
    b. Relief/Exhaust fan shall run whenever the supply fan runs.
    c. Relief air dampers shall be enabled whenever the supply fan runs
    d. Outside air dampers shall be set to minimum position, and enable mixed air and economizer functions.
    e. Unit operates as outlined above.
3. Unoccupied Mode:
    a. The supply fan shall be de-energized unless there is a call for heating or cooling in the system by any five (5) zones (adjustable), or if a single zone temperature deviates from temperature of greater than 5 degrees F (adjustable).
    b. Relief/Exhaust fan shall be de-energized.
    c. Both outdoor air dampers and exhaust dampers shall be closed. The return air damper shall be open.
    d. Unit heating and cooling coils operate as outlined above to maintain discharge air temperature setpoint.
4. Morning Warm-up:
    a. When the outside air temperature is below 55 degrees F, the DDC system shall perform a morning warm-up cycle prior to the occupied mode.
    b. The supply fan shall operate
    c. The relief/exhaust fan shall not operate
    d. The relief air dampers shall be closed
    e. The outside air damper shall be closed and the return air damper shall be open.
    f. Unit heating coil shall operate as outlined above to maintain discharge air temperature setpoint.
    g. Cooling shall be disabled.
    h. The Air Handling Unit shall remain in the morning warm-up mode until all zones are at their occupied space temperature setpoint. Once all zones are at occupied temperature, enable occupied mode.
5. Morning Cool-down:
    a. When the system is in cooling night setback, the DDC system shall perform a morning cool-down cycle prior to the occupied mode.
    b. If outside air temperature is below average space temperature:
        1) The supply fan shall operate.
        2) The relief/exhaust fan shall operate
        3) The relief air dampers shall be open
        4) The outside air dampers shall open, and return air damper shall close.
        5) The cooling and heating systems shall be disabled.
    c. If the outside air temperature is above average space temperature:
        1) The supply fan shall operate.
        2) The relief/exhaust fan shall not operate
        3) The relief air dampers shall be closed
        4) The outside air dampers shall close, and the return air damper shall open.
        5) The cooling system shall be enabled and operate as outlined above to maintain discharge air temperature setpoint.
        6) Heating system shall be disabled.
    d. The Air Handling Unit shall remain in the morning cool-down mode until all zones are at their occupied space temperature setpoint. Once all zones are at occupied temperature, enable occupied mode

E. Safety Interlocks and Overrides:
1. Smoke Detectors: On the detection of smoke from a duct mounted smoke detector, a hard wired interlock with the supply fan shall shut down the supply fan and return fan. through a signal to the VFD. The unit outside air and unit relief. air dampers shall close. The smoke detector shall be furnished and wired by electrical and installed by mechanical. The duct mounted smoke detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider.

2. Freezestat: Freezestat located just downstream of the HW coil. in the air handling unit shall cause the following, upon sensing a temperature less than 38 degrees F (adj.): The supply fan shall stop, return fan. shall stop, all dampers shall close to outside air and the heating valve shall open to 100% or a programmed amount. An alarm shall be initiated to the BAS.
3. Supply Air Low Limit: Discharge air temperature sensor shall initiate an alarm, close outside air dampers, and modulate the hot water. control valve open if the supply air temperature drops below 45 degrees F. when unit is in heating mode. Function disabled during cooling mode. This has priority over the needs of discharge air and CO2 control loops.
4. Carbon Monoxide Detectors: On the detection of carbon monoxide from a duct mounted CO detector, a hard wired interlock with the supply fan shall shut down the supply fan and exhaust fan through a signal to the VFD. The unit outside air damper shall close. The CO detector shall be furnished and wired by electrical and installed by mechanical. The duct mounted CO detector shall initiate an alarm to the fire alarm system. Coordinate detector requirements with controls contractor, and fire alarm system provider
5. Duct Static Safety: A manual reset, high limit static pressure switch, located in the supply duct shall shut down the supply fan if it senses a static pressure above 2.5" (adj) WC. Initial high static pressure limit shall be set at 0.5” WC above scheduled external static pressure.
6. Economizer Fault Detection: Provide economizer fault detection as outlined below:
    a. Utilize the outside air temperature sensor, supply air temperature sensor, and return air temperature sensor for temperature readings.
    b. Unit controller shall provide system status by indicating the following:
        1) Free cooling (economizer) available
        2) Economizer enabled
        3) Compressor enabled
        4) Heating enabled
        5) Mixed air low limit cycle active
        6) Temperature of sensors listed above.
    c. Unit shall report faults to a fault management application to report the following faults:
        1) Air temperature sensor failure/fault
        2) System not economizing when unit should be economizing
        3) System economizing when should not be economizing
        4) Damper not modulating
        5) Excess outdoor air.

F. Monitor and Alarm Points: The value, binary state, setpoint, voltage, run hours, etc. of any input, output, control loop or virtual point shall be monitored on screen. Terminal mode group information screens shall be provided per the standards required by the District.

G. Operator Station Display:
1. System occupied/unoccupied mode.
2. Supply fan on/off indication.
3. Supply fan current sensing relay alarm.
4. Supply fan VFD alarm
5. Supply fan VFD speed indication
6. Relief/Exhaust fan on/off indication
7. Relief/Exhaust fan current sensing relay alarm
8. Relief/Exhaust fan VFD alarm
9. Relief/Exhaust fan VFD speed indication
10. Outside air temperature indication
11. Mixed air temperature indication
12. Return air temperature indication
13. Unit discharge air temperature indication.
14. Chilled water control valve position
15. DX system Enable
16. Heating water control valve position
17. Freeze stat alarm
18. Smoke alarm

19. Outside air setpoint
20. Outside air flow
21. Outside air temperature indication
22. Supply air discharge temperature control point adjustment
23. Supply static pressure indication
24. Supply static pressure control point adjustment
25. Building static pressure indication
26. Building static pressure control point adjustment
27. HW coil circulation pump on/off indication
28. HW coil circulation pump current sensing relay alarm
29. Unit CO2 level indication
30. Unit CO2 level control point adjustment.
31. Supply air CO alarm
32. Filter high static alarm
33. Economizer Fault - Temperature Sensor Fault/Failure
34. Economizer Fault - Economizer Enabled - Not Operating
35. Economizer Fault - Economizer Disabled - Operating
36. Economizer Fault - Excess Outdoor Air

3.02 VAV TERMINAL UNIT SEQUENCES OF OPERATION

A. Temperature Setpoints:
   1. Occupied Space Temperature: 75 deg F. cooling, 70 Deg F. heating
   2. Un-Occupied Space Temperature: 85 deg F. cooling, 65 Deg F. heating
   3. Heating Discharge Air Temperature: 90 deg F.

B. VAV Box Operation:
   1. Cooling: Sequence damper from full open to minimum position. HW coil valve is closed.
   2. Heating: Sequence damper from minimum to maximum heating and concurrently modulate HW coil control valve to maintain space temperature.
   3. Heating: Sequence damper from minimum to maximum heating and modulate electric heat states to maintain space temperature.

C. Room CO2 Level Control
   1. During occupied mode, if the CO2 level rises above the space setpoint of 700. ppm (adj), the air valve (damper) shall slowly increment open as necessary to regain and maintain an allowable CO2 level. If the air valve (damper) when fully open, cannot maintain the proper CO2 level, the air handling unit is notified and shall slowly open its mixing damper to allow additional outside air.

D. Display
   1. System graphic
      a. Occupied/Unoccupied
      b. Space temperature setpoint
      c. Space temperature indication/adjustment
      d. Control valve position
      e. Space CO2 Level
      f. Space CO2 Setpoint
      g. Space High CO2 Alarm

3.03 EXHAUST FAN SEQUENCES

A. DDC Interlocked Fans: Fans shall be enabled when the associated air handling unit is in occupied mode.
   1. Display and Alarms
      a. System graphic
      b. Fan status/alarm

END OF SECTION

SECTION 231123
FACILITY NATURAL-GAS PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Pipe, pipe fittings, valves, and connections for natural gas piping systems.

1.02 RELATED REQUIREMENTS

A. Section 230553 - Identification for HVAC Piping and Equipment.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.

B. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300; 2016.

C. ASME B31.1 - Power Piping; 2020.

D. ASME B31.9 - Building Services Piping; 2020.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

F. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

1.04 SUBMITTALS

A. See Division 01 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

C. Welders' Certificates: Submit certification of welders' compliance with ASME BPVC-IX.

D. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Valves: Manufacturer's name and pressure rating marked on valve body.

B. Welding Materials and Procedures: Comply with ASME BPVC-IX and applicable state labor regulations.

C. Welder Qualifications: Certified in accordance with ASME BPVC-IX.

PART 2 PRODUCTS

2.01 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53/A53M, Schedule 40 black.
   1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M, wrought steel welding type.
   2. Joints: Threaded (2 inch and smaller) or welded (2-1/2 inch and larger) to ASME B31.1.

2.02 FLANGES, UNIONS, AND COUPLINGS

A. Unions for Pipe Sizes 2 Inches and Under:
   1. Ferrous Pipe: Class 150 malleable iron threaded unions.

B. Flanges for Pipe Size Over 2-1/2 Inches

1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

2.03 PIPE HANGERS AND SUPPORTS

A. Refer to Section 230529 for hanger and support component requirements.

B. Provide hangers and supports that comply with MSS SP-58.
1. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
2. Overhead Supports: Individual steel rod hangers attached to structure or to trapeze hangers.
3. Trapeze Hangers: Welded steel channel frames attached to structure.
4. Vertical Pipe Support: Steel riser clamp.

2.04 BALL VALVES

A. Construction, 2 Inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, ductile iron body, 304 stainless steel ball, regular port, Teflon seats and stuffing box ring, blow-out proof stem, lever handle, threaded ends with union.

2.05 STRAINERS

A. Size 2 inch and Under:
1. Threaded brass body for 175 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.
2. Class 150, threaded bronze body 300 psi CWP, Y pattern with 1/32 inch stainless steel perforated screen.

B. Size 2-1/2 inch to 4 inch:
1. Class 125, flanged iron body, Y pattern with 1/16 inch stainless steel perforated screen.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

C. Install piping to maintain headroom, conserve space, and not interfere with use of space.

D. Group piping whenever practical at common elevations.

E. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

F. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.
1. Painting of interior piping systems and components is specified in Section 099123.

G. Install valves with stems upright or horizontal, not inverted.

H. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

I. Sleeve pipes passing through partitions, walls and floors.

J. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9.

3.03 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.

B. Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

C. Install ball valves for throttling, bypass, or manual flow control services.

3.04 FIELD TESTS AND INSPECTIONS

A. Gas Distribution Systems:
   1. Test Preparation: Close each appliance valve or disconnect and cap each connected appliance.
   2. General Systems:
      a. Inject a minimum of 10 psi of compressed air into the piping system for a duration of 15 minutes and verify with a gauge that no perceptible pressure drop is measured.
      b. Ensure test pressure gauge has a range of twice the specific pressure rate selected with an accuracy of 1/10 of 1 pound.

B. Test Results: Document and certify successful results, otherwise repair, document, and retest.

3.05 SCHEDULES

A. Pipe Hanger Spacing:
   1. Metal Piping:
      a. Pipe Size: 1/2 inches to 1-1/4 inches:
         1) Maximum Hanger Spacing: 6.5 ft.
         2) Hanger Rod Diameter: 3/8 inches.
      b. Pipe Size: 1-1/2 inches to 2 inches:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 3/8 inch.
      c. Pipe Size: 2-1/2 inches to 3 inches:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 1/2 inch.
      d. Pipe Size: 4 inches to 6 inches:
         1) Maximum Hanger Spacing: 10 ft.
         2) Hanger Rod Diameter: 5/8 inch.

END OF SECTION

SECTION 232113
HYDRONIC PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic system requirements.

B. Unions, flanges, mechanical couplings, and dielectric connections.

1.02 RELATED REQUIREMENTS

A. Division 07 for firestopping.

B. Section 230523 - General-Duty Valves for HVAC Piping.

C. Section 230719 - HVAC Piping Insulation.

D. Section 232114 - Hydronic Specialties.

E. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators; 2021.

B. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings; 2018.

C. ASME B16.22 - Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings; 2018.

D. ASME B31.9 - Building Services Piping; 2020.

E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2020.

F. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service; 2019.

G. ASTM B32 - Standard Specification for Solder Metal; 2020.

H. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2020.

I. ASTM B88M - Standard Specification for Seamless Copper Water Tube (Metric); 2020.

J. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020.

K. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Welders Certificate: Include welders certification of compliance with ASME BPVC-IX.

C. Product Data:
1. Include data on pipe materials, pipe fittings, valves, and accessories.

D. Project Record Documents: Record actual locations of valves.

1.05 QUALITY ASSURANCE

A. Welder Qualifications: Certify in accordance with ASME BPVC-IX.

1. Provide certificate of compliance from authority having jurisdiction, indicating approval of welders.

B. Qualifications:
   1. Any Journeyman Pipefitter, HVAC installer or Steamfitter working on the jobsite shall be licensed by “City and County of Denver.”
   2. Acceptable contractor licenses are as follows:
      a. Heating and ventilating journeyman
      b. Refrigeration journeyman
      c. Steamfitter journeyman
      d. Any mechanical supervisor’s certificate
   3. An equal license or certificate may be presented and must be approved by the District Project Manager.
   4. The license must be on their person at all times while on the jobsite and be available for inspection by Jeffco staff at any time during the work.

C. Allowable Journeyman/Apprentice Ratios:
   1. The installer (contractor) must use apprentices on the jobsite. At no time shall the ratio of two apprentices to one journeyman be exceeded on the jobsite.

D. Welded pipe installer qualifications.
   1. Pipe welds must be performed by a certified welder. Welder must be certified in SMAW-E6010, E7018, which falls under section IX of the ASME code, Boiler and Pressure Vessel (welding and brazing), ASME B31 and Appendix B31.1 2007, Power Piping Welding Procedures. Welder certifications shall be verified before installation starts.
   2. Jefferson County Public Schools also requires welded pipe installers to be ASME certified when welding on systems less than 30 psig.

PART 2 PRODUCTS

2.01 HYDRONIC SYSTEM REQUIREMENTS

A. Comply with ASME B31.9 and applicable federal, state, and local regulations.

B. Piping: Provide piping, fittings, hangers and supports as required, as indicated, and as follows:
   1. Where more than one piping system material is specified, provide joining fittings that are compatible with piping materials and ensure that the integrity of the system is not jeopardized.
   2. Make all connections between ferrous and non-ferrous material through brass fittings. Install isolation valve on ferrous side of brass fitting. Dielectric fittings are prohibited
   3. Provide pipe hangers and supports in accordance with ASME B31.9 or MSS SP-58 unless indicated otherwise.

C. Pipe-to-Valve and Pipe-to-Equipment Connections: Use flanges or unions to allow disconnection of components for servicing; do not use direct welded, soldered, or threaded connections.

D. Valves: Provide valves where indicated:
   1. Provide drain valves where indicated, and if not indicated provide at least at main shut-off, low points of piping, bases of vertical risers, and at equipment. Use 3/4 inch ball valves with cap; pipe to nearest floor drain.
   2. For throttling, bypass, or manual flow control services, use ball or butterfly valves.
   3. For shut-off and to isolate parts of systems or vertical risers, use ball or butterfly valves.

E. Welding Materials and Procedures: Conform to ASME BPVC-IX.

2.02 HEATING WATER PIPING, ABOVE GRADE

A. Steel Pipe (2 1/2 inch and Larger): ASTM A 53/A 53M, Schedule 40, black.
   1. Welded Joints: ASTM A234/A234M, wrought steel welding type fittings; AWS D1.1/D1.1M welded.

B. Copper Tube (2 inch and smaller): ASTM B 88 (ASTM B 88M), Type L (B), drawn.
   1. Fittings: ASME B16.22, wrought copper.
      a. Solder: ASTM B32 lead-free solder, HB alloy (95-5 tin-antimony) or tin and silver.
   2. Mechanical Press Sealed Fittings: Double pressed type complying with ASME B16.22, utilizing EPDM, nontoxic synthetic rubber sealing elements.
      a. Manufacturers:
         1) Apollo Valves: www.apollovalves.com/#sle.
         2) Grinnell Products, a Tyco Business: www.grinnell.com/#sle.
         3) Viega LLC: www.viega.com/#sle.
         4) Pro-Press.
         5) Substitutions: See Division 01 for product requirements.
   3. Tee Connections: Tee fittings in main pipe.

2.03 UNIONS, FLANGES, MECHANICAL COUPLINGS, AND DIELECTRIC CONNECTIONS

A. Unions for Pipe 2 Inches and Less:
   1. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe 2 Inches and Greater:
   1. Ferrous Piping: 150 psig forged steel, slip-on.
   2. Gaskets: 1/16 inch thick preformed neoprene.

C. Dielectric Connections:
   1. Are prohibited, use brass fittings between dissimilar metals.
   2. Make all connections between ferrous and non-ferrous material through brass fittings. Install isolation valve on ferrous side of brass fitting. Dielectric fittings are prohibited.

PART 3 EXECUTION

3.01 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt on inside and outside before assembly.

C. Prepare piping connections to equipment using jointing system specified.

D. Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.

E. After completion, fill, clean, and treat systems. Refer to Section 232500 for additional requirements.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install heating water, glycol, and piping to ASME B31.9 requirements.

C. Route piping in orderly manner, parallel to building structure, and maintain gradient.

D. Install piping to conserve building space and to avoid interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.

G. Slope piping and arrange to drain at low points.

3.03 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball and butterfly valves.

2. Pump-Discharge Check Valves:
    a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.
    b. NPS 2 1/2 and Larger: Iron swing check valves with lever and weight or with spring or iron, center-guided check valves.

3.04 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:
    1. Leave joints, including welds, uninsulated and exposed for examination during test.
    2. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
    3. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
    4. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:
    1. Use ambient temperature water as a testing medium unless there is a risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
    2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
    3. Isolate expansion tanks and determine that hydronic system is full of water.
    4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
    5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are not leaks.
    6. Prepare written report of testing.

C. Perform the following before operating the system:
    1. Open manual valves fully.
    2. Inspect pumps for proper rotation.
    3. Set makeup pressure-reducing valves for required system pressure.
    4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
    5. Set temperature controls so all coils are calling for full flow.
    6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
    7. Verify lubrication of motors and bearings.

END OF SECTION

SECTION 232114
HYDRONIC SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Expansion tanks.

B. Air vents.

C. Air separators.

D. Strainers.

E. Suction diffusers.

F. Balancing valves.

G. Glycol system.

1.02 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping.

B. Section 232500 - HVAC Water Treatment: Pipe cleaning.

1.03 REFERENCE STANDARDS

A. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1: Rules for Construction of Pressure Vessels; 2021.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description and model.

PART 2 PRODUCTS

2.01 EXPANSION TANKS

A. Manufacturers:
   1. Amtrol Inc: www.amtrol.com/#sle.
   2. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.

B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, adjustable flexible EPDM diaphragm or bladder seal factory precharged to 12 psi, and steel support stand.

C. Automatic Cold Water Fill Assembly: Pressure reducing valve, reduced pressure double check backflow preventer, test cocks, strainer, vacuum breaker, and valved by-pass.

D. Accessories: Provide air-charging fitting, bulls eye sight glass, pressure gauge, and tank drain ball valve.

2.02 AIR VENTS

A. Manufacturers:
   1. Armstrong International, Inc: www.armstronginternational.com/#sle.
   2. ITT Bell & Gossett: www.bellgossett.com/#sle.
   3. Taco, Inc: www.taco-hvac.com/#sle.

B. Float Type:
   1. Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

C. Washer Type:
   1. Brass with hygroscopic fiber discs, vent ports, adjustable cap for manual shut-off, and integral spring loaded ball check valve.

D. Maximum Fluid Pressure: 150 psi.

E. Maximum Fluid Temperature: 250 degrees F.

2.03 AIR SEPARATORS

A. Coalescing Air/Dirt Separators:
   1. Manufacturers:
      a. Armstrong International, Inc: www.armstronginternational.com/#sle.
      b. Bell & Gossett, a brand of Xylem, Inc: www.bellgossett.com/#sle.
   2. Tank: Fabricated steel tank; tested and stamped in accordance with ASME BPVC-VIII-1 for maximum fluid service subject to application requirements and manufacturer's standard maximum operating conditions.
   3. Coalescing Medium: Provide structured copper or stainless steel medium filling the entire vessel to suppress turbulence and provide air elimination efficiency of 100 percent free air, 100 percent entrained air, and 99.6 percent dissolved air at the installed location.
   4. Air Vent: Integral float actuated air vent at top fitting of tank rated at 150 psi, threaded to top of separator.
   5. End Connections: Class 150 flanged for 2-1/2 inch and larger otherwise threaded.
   6. Blowdown Connection: Threaded.
   7. Size: Match system flow capacity.
   8. Maximum Fluid Service Pressure: 150 psi.
   9. Maximum Fluid Service Temperature: 250 degrees F.

2.04 Y-PATTERN STRAINERS

A. Manufacturers:
   1. ITT Bell & Gossett: www.bellgossett.com.
   2. Taco, Inc: www.taco-hvac.com.
   3. Apollo Valves; Manufactured by convraco; www.apollovalves.com.
   4. Hammond Valve; www.hammondvalve.com.

B. Size 2 inch and Under:
   1. Screwed brass or iron body for 175 psi working pressure, Y pattern with 1/32 inch stainless steel perforated screen.

C. Size 2-1/2 inch to 4 inch:
   1. Provide flanged iron body for 175 psi working pressure, Y pattern with 3/64 inch stainless steel perforated screen.

2.05 SUCTION DIFFUSERS

A. Fitting: Angle pattern, cast-iron body, threaded for 2 inch and smaller, flanged for 2-1/2 inch and larger, rated for 175 psi working pressure, with inlet vanes, cylinder strainer with 3/16 inch diameter openings, disposable 5/32 inch mesh strainer to fit over cylinder strainer, 20 mesh start up screen, and permanent magnet located in flow stream and removable for cleaning.

B. Accessories: Adjustable foot support, blowdown tapping in bottom, gage tapping in side.

2.06 PUMP CONNECTORS

A. Manufacturers:

1. Anvil International: www.anvilintl.com/#sle.
2. The Metraflex Company: www.metraflex.com/#sle.
3. Substitutions: See Division 01 - Product Requirements

B. Flexible Connectors: Flanged, braided type with wetted components of stainless steel, sized to match piping.
1. Maximum Allowable Working Pressure: 150 psig at 120 degrees F.
2. Accommodate the Following:
a. Axial Deflection in Compression and Expansion: 0.5 inch.
b. Lateral Movement: 0.5 inch.
c. Angular Rotation: 15 degrees.
d. Force developed by 1.5 times specified maximum allowable operating pressure.
3. End Connections: Same as specified for pipe jointing.

2.07 BALANCING VALVES

A. Manufacturers:
1. Armstrong International, Inc: www.armstronginternational.com/#sle.
2. ITT Bell & Gossett: www.bellgossett.com/#sle.
3. Taco, Inc: www.taco-hvac.com/#sle.
4. Tyco Flow Control; www.tycoflowcontrol.com
5. Griswold Controls; www.griswoldcontrols.com
6. Substitutions: See Division 01 for product requirements.

B. Size 2 inch and Smaller:
1. Provide ball style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and NPT threaded connections.
2. Metal construction materials consist of bronze.
3. Non-metal construction materials consist of EPDM.

C. Size 2.5 inch and Larger:
1. Provide butterfly style with flow balancing, flow measurement, and shut-off capabilities, memory stops, minimum of two metering ports and flanged connections.
2. Valve body construction materials consist of carbon steel or ductile iron.
3. Internal components construction materials consist of aluminum bronze, Teflon, EPDM, NORYL, or engineered resin.

2.08 GLYCOL SYSTEM

A. Glycol Solution:
1. Inhibited propylene glycol and water solution mixed 30 percent glycol - 70 percent water, suitable for operating temperatures from minus 18 degrees F to 250 degrees F.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install specialties in accordance with manufacturer's instructions.

B. Where large air quantities can accumulate, provide enlarged air collection standpipes.

C. Provide manual air vents at system high points and as indicated.

D. For automatic air vents in ceiling spaces or other concealed locations, provide vent tubing to nearest drain.

E. Provide air separator on suction side of system circulation pump and connect to expansion tank.

F. Provide valved drain and hose connection on strainer blow down connection.

G. Provide pump suction fitting on suction side of base mounted centrifugal pumps. Remove temporary strainers after cleaning systems.

H. Support pump fittings with floor mounted pipe and flange supports.

I. Clean and flush glycol system before adding glycol solution. Refer to Section 232500.

J. Feed glycol solution to system through make-up line with pressure regulator, venting system high points.

K. Perform tests determining strength of glycol and water solution and submit written test results.

L. Install manual air vents at heat transfer coils, and terminal equipment.

M. Install in-line air separators in pump suction. Install drain valve on air separators 2" and larger.

END OF SECTION

SECTION 232123
HYDRONIC PUMPS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Base-mounted pumps.

1.02 RELATED REQUIREMENTS

A. Division for cast-in-place concrete.

B. Section 230513 - Common Motor Requirements for HVAC Equipment.

C. Section 230719 - HVAC Piping Insulation.

D. Section 232113 - Hydronic Piping.

E. Section 232114 - Hydronic Specialties.

F. Section 251400 - Integrated Automation Local Control Units.

G. Division 26 for electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. UL 778 - Standard for Motor-Operated Water Pumps; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Indicate hanging and support requirements and recommendations.

D. Operation and Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Armstrong Fluid Technology, Inc: www.armstrongfluidtechnology.com/#sle.

B. Bell & Gossett, a Xylem Inc. brand: www.bellgossett.com/#sle.

C. Peerless.

D. TACO, Inc.; www.taco-hvac.com.

E. Substitutions: Not permitted.

2.02 HVAC PUMPS - GENERAL

A. Provide pumps that operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

B. Base Mounted Pumps: Aligned by qualified millwright.

C. Products Requiring Electrical Connection: Listed and classified by UL as suitable for the purpose specified and indicated.

2.03 BASE-MOUNTED PUMPS

A. Type: Horizontal shaft, single stage, direct connected, radially split casing, for 125 psi maximum working pressure.

B. Casing: Cast iron with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.

C. Impeller: Bronze, fully enclosed, keyed to shaft.

D. Bearings: Oil lubricated roller or ball bearings.

E. Shaft: Alloy steel with copper, bronze, or stainless steel shaft sleeve.

F. Seal: Manufacturer's standard seal, 225 degrees F maximum continuous operating temperature.

G. Drive: Flexible coupling with coupling guard.

H. Baseplate: Cast iron or fabricated steel with integral drain rim.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide access space around pumps for service. Provide no less than minimum space recommended by manufacturer.

C. Provide line sized shut-off valve and strainer on pump suction, and line sized soft seat check valve and balancing valve on pump discharge.

D. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Division 03.

E. Lubricate pumps before start-up.

F. Controls Human-Machine Interface (HMI): HVAC operator terminal; see Section 253500.

3.03 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:
      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.
   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   6. Start motor.
   7. Open discharge valve slowly.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps. Refer to Division 01 Section for demonstration and training.

END OF SECTION

SECTION 232500
HVAC WATER TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Materials.
   1. System cleaner.
   2. Closed system treatment (water).

B. Filter feeder.

C. Glycol feed equipment

1.02 RELATED REQUIREMENTS

A. Section 232114 - Hydronic Specialties.

1.03 REFERENCE STANDARDS

A. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

A. Product Data: Provide chemical treatment materials, chemicals, and equipment including electrical characteristics and connection requirements.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable code for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

A. Comply with applicable codes for addition of non-potable chemicals to building mechanical systems and to public sewage systems.

B. Comply with UL (DIR) requirements.

C. Perform work in accordance with local health department regulations.

2.02 MATERIALS

A. System Cleaner:
   1. Liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products; sodiumtripoly phosphate and sodium molybdate.
   2. Biocide chlorine release agents such as sodium hypochlorite or calcium hypochlorite or microbiocides such as quarternary ammonia compounds, tributyltin oxide, methylene bis (thiocyanate).

B. Closed System Treatment (Water):
   1. Sequestering agent to reduce deposits and adjust pH; polyphosphate.
   2. Corrosion inhibitors; boron-nitrite, sodium nitrite and borax, sodium totyltriazole, low molecular weight polymers, phosphonates, sodium molybdate, or sulphites.
   3. Conductivity enhancers; phosphates or phosphonates.

2.03 FILTER FEEDER

A. Manufacturers:
   1. Griswold Controls: www.griswoldcontrols.com/#sle.

2. J. L. Wingert Company: www.jlwingert.com/#sle.
3. Neptune, a brand of the Dover Company: www.neptune1.com/#sle.

B. By pass type 2 gallon capacity steel tank, with 3-1/2" feed opening and intergral metal basket and 5 micron cloth media filter.

2.04 GLYCOL FEEDER ASSEMBLY

A. Glycol feeder unit shall be a packaged unit manufactured by a company with a minimum of 5 years of manufacturing experience. Field assembled or built up systems by the contractor are not acceptable. Unit shall be included but are not limited to:
1. Manufacturers:
   a. Axiom, Model SF100 Packaged Hydronic System Feeder
2. Reservoir tank - 55 gallon minimum, polyethylene with removable cover and hose bib drain mounted on steel stand with four legs with foot pads.
3. Positive displacement rotary gear pump 115/60/1 manufacturered by Oberdofer, Dresser, Pulsafeeder, Viking or approved alternate.
4. NEMA Type 1, control enclosure.
5. Control panel shall be UL listed as a unit.
6. Momentary spring loaded push button switch for testing the operation of the pump.
7. Relief valve adjustable between 10 and 20 psi.
8. Dual point float switch to protect pump from low level and dry contacts to connect alarm to building automation system.
9. Pressure switch for pump control shall be Furnas Model 69WB3 (3-35 psi). Locate pressure switch in loop main.
10. Provide a 30 second delay on pump start.
11. All rigid piping shall be type L copper.
12. Manual fill only with an air gap connection from the potable water supply down stream of the building backflow preventer. Make no hard connections to the water supply.
13. Deliver system to the owner with a full reservoir tank of 30% inhibited propylene glycol solution.

PART 3 EXECUTION

3.01 PRE-CONSTRUCTION

A. Perform pre-construction water analysis to determine existing piping system(s) glycol level. Report glycol level to district Project Manager.

3.02 PREPARATION

A. System clean and flush and glycol requirements apply to new piping systems and extents of exiting piping systems modified.

B. Systems shall be operational, filled, started, and vented prior to cleaning. Use water meter to record capacity in each system.

C. Place terminal control valves in open position during cleaning.

D. Verify that electric power is available and of the correct characteristics.

E. Notify the Jefferson County School District, R-1 Project Manager five (5) work days in advance of starting cleaning.

F. Cleaning and flushing of all systems shall take place in the presence of the Jefferson County School District, R-1 Project Manager and District personnel.

G. “Certification of Work Certificate” documents the cleaning procedure and personnel involved.

H. The designated representative observing the cleaning shall sign the certification.
1. School personnel or custodial staff are not authorized to certify the procedure.

3.03 CLEANING SEQUENCE

A. Concentration:
   1. As recommended by manufacturer.

B. Hot Water Heating Systems:
   1. Apply heat while circulating, slowly raising temperature to 160 degrees F and maintain for 12 hours minimum.
   2. Remove heat and circulate to 100 degrees F or less; drain systems as quickly as possible and refill with clean water.
   3. Circulate for 6 hours at design temperatures, then drain.
   4. Refill with clean water and repeat until system cleaner is removed.

C. Remove, clean, and replace strainer screens.

D. Inspect, remove sludge, and flush low points with clean water after cleaning process is completed. Include disassembly of components as required.

3.04 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.05 CLOSED SYSTEM TREATMENT

A. Provide one bypass feeder on each system. Install isolating and drain valves and necessary piping. Install around balancing valve downstream of circulating pumps unless indicated otherwise.

B. Introduce closed system treatment through bypass feeder when required or indicated by test.

END OF SECTION

SECTION 233100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

1.02 RELATED REQUIREMENTS

A. Section 230713 - Duct Insulation: External insulation and duct liner.

B. Section 233300 - Air Duct Accessories.

C. Section 233600 - Air Terminal Units.

D. Section 233700 - Air Outlets and Inlets.

E. Section 230593 - Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCE STANDARDS

A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; Most Recent Edition Cited by Referring Code or Reference Standard.

B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.

C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2020.

D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.

E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2021a.

F. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

H. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; 2003.

1.04 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

A. See Division 01 for submittal procedures

B. See Section 23 0100 for additional submittal requirements.

C. Product Data: Provide data for duct liner and duct connections.

1.06 QUALITY ASSURANCE

A. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

1.07 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A standards.

1.08 FIELD CONDITIONS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 MATERIALS

A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Galvanealed Steel for Paintable Ducts (Paintlock): of-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating, and alloyed for paint adherence.

C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.
   3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
   4. For Use With Flexible Ducts: UL labeled.
   5. For exterior mounted duct provided airtight and watertight mastic/sealer rated from -30 to 175 degree F per SMACNA requirements.

D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

E. Ducts: Galvanized steel, unless otherwise indicated.

F. All Exposed Ducts: Galvanealed steel (Paintlock), unless otherwise indicated. Refer to architectural drawings for exposed ducts to be painted

G. Low Pressure Supply (System with Cooling Coils): 1 inch w.g. pressure class, galvanized steel.

H. Medium and High Pressure Supply: 4 inch w.g. pressure class, galvanized steel.

I. Return and Relief: 1/2 inch w.g. pressure class, galvanized steel.

J. General Exhaust: 1/2 inch w.g. pressure class, galvanized steel.

K. Transfer Air and Sound Boots: 1/2 inch w.g. pressure class, fibrous glass.

2.02 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.

B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.

C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.

E. T's, bends, and elbows: Construct according to SMACNA (DCS).

F. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

G. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

H. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages,reinforcing, and sealing for operating pressures indicated.

B. Flexible Ducts: Black polymer film supported by helically wound spring steel wire.
1. UL labeled.
2. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
3. Pressure Rating: 4 inches WG positive and 0.5 inches WG negative.
4. Maximum Velocity: 4000 fpm.
5. Temperature Range: Minus 20 degrees F to 175 degrees F.

C. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

2.04 FIBROUS GLASS DUCTS (RETURN AIR SOUND BOOTS ONLY)

A. Fibrous Glass Ducts: 1 inch thick rigid glass fiber with aluminum foil, glass scrim and Kraft or plastic jacket vapor barrier; maximum 0.23 K value at 75 degrees F.

B. Fabricate in accordance with SMACNA (FGD), except as indicated.

C. Machine fabricate fibrous glass ducts and fittings. Make only minor on site manual adjustments.

D. Staple duct joints and tape with 3 inch wide 2 mil thick or 2 inch wide 3 mil thick aluminum pressure sensitive tape, UL approved.

E. Do not use fibrous glass ducts within 12 inches of electric or fuel fired heaters.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA (DCS).

B. Install in accordance with manufacturer's instructions.

C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Duct sizes indicated are inside clear dimensions. For lined return air transfer ducts, maintain sizes inside lining.

E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. Install fibrous glass ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

G. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with

spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

H. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

I. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 feet maximum length of flexible duct held in place with strap or clamp.

J. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.02 CLEANING

A. Clean duct systems with high power vacuum machines. Protect equipment that could be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes.

END OF SECTION

SECTION 233300
AIR DUCT ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Air turning devices/extractors.

B. Flexible duct connections.

C. Volume control dampers.

1.02 RELATED REQUIREMENTS

A. Section 233100 - HVAC Ducts and Casings.

B. Section 233600 - Air Terminal Units: Pressure regulating damper assemblies.

C. Division 26 for electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

B. NFPA 92A - Standard for Smoke-Control Systems Utilizing Barriers and Pressure Differences; 2012.

C. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Revised 2009).

D. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.

E. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide for shop fabricated assemblies including volume control dampers and duct access doors. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Provide instructions for fire dampers and combination fire and smoke dampers.

D. Project Record Drawings: Record actual locations of access doors and test holes.

1.05 QUALITY ASSURANCE

A. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

PART 2 PRODUCTS

2.01 AIR TURNING DEVICES/EXTRACTORS

A. Multi-blade device with blades aligned in short dimension; steel construction; with individually adjustable blades, mounting straps.

2.02 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.03 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Flexible Duct Connections: Fabric crimped into metal edging strip.
   1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd.
   2. Metal: 3 inches wide, 24 gage, 0.0239 inch thick galvanized steel.

C. Maximum Installed Length: 6 inch.

2.04 VOLUME CONTROL DAMPERS

A. Fabricate in accordance with SMACNA (DCS) and as indicated.

B. Splitter Dampers:
   1. Material: Same gage as duct to 24 inches size in either direction, and two gages heavier for sizes over 24 inches.
   2. Blade: Fabricate of single thickness sheet metal to streamline shape, secured with continuous hinge or rod.
   3. Operator: Minimum 1/4 inch diameter rod in self aligning, universal joint action, flanged bushing with set screw .

C. Single Blade Dampers: Fabricate for duct sizes up to 6 x 30 inch.
   1. Fabricate for duct sizes up to 6 x 30 inch.
   2. Blade: 24 gage, 0.0239 inch, minimum.

D. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch. Assemble center and edge crimped blades in prime coated or galvanized channel frame with suitable hardware.
   1. Blade: 18 gage, 0.0478 inch, minimum.

E. End Bearings: Except in round ducts 12 inches and smaller, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, thermoplastic elastomer, or sintered bronze bearings.

F. Quadrants:
   1. Provide locking, indicating quadrant regulators on single and multi-blade dampers.
   2. On insulated ducts mount quadrant regulators on stand-off mounting brackets, bases, or adapters.
   3. Where rod lengths exceed 30 inches provide regulator at both ends.

2.05 MISCELLANEOUS PRODUCTS

A. Duct Opening Closure Film: Mold-resistant, self-adhesive film to keep debris out of ducts during construction.
   1. Thickness: 2 mils.
   2. High tack water based adhesive.
   3. UV stable light blue color.
   4. Elongation Before Break: 325 percent, minimum.

PART 3 EXECUTION

3.01 PREPARATION

A. Verify that electric power is available and of the correct characteristics.

3.02 INSTALLATION

A. Install accessories in accordance with manufacturer's instructions, NFPA 90A, and follow SMACNA (DCS). Refer to Section 233100 for duct construction and pressure class.

B. Provide backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

C. Provide duct test holes where indicated and required for testing and balancing purposes.

D. Provide fire dampers and combination fire and smoke dampers at locations indicated, where ducts and outlets pass through fire rated components, and where required by Authorities Having Jurisdiction. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. At fans and motorized equipment associated with ducts, provide flexible duct connections immediately adjacent to the equipment.

F. At equipment supported by vibration isolators, provide flexible duct connections immediately adjacent to the equipment.

G. Provide balancing dampers at points on supply, return, and exhaust systems where branches are taken from larger ducts as required for air balancing. Install minimum 2 duct widths from duct take-off.

H. Use splitter dampers only where indicated.

I. Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

SECTION 233423
HVAC EXHAUST FANS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Roof exhausters.

1.02 RELATED REQUIREMENTS

A. Division for electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

A. AMCA (DIR) - (Directory of) Products Licensed Under AMCA International Certified Ratings Program; 2015.

B. AMCA 99 - Standards Handbook; 2016.

C. AMCA 204 - Balance Quality and Vibration Levels for Fans; 2020.

D. AMCA 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating; 2016.

E. AMCA 300 - Reverberant Room Method for Sound Testing of Fans; 2014.

F. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; 2014.

1.04 SUBMITTALS

A. Product Data: Provide data on fans and accessories including fan curves with specified operating point clearly plotted, power, RPM, sound power levels at rated capacity, and electrical characteristics and connection requirements.

B. Manufacturer's Instructions: Indicate installation instructions.

C. Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.06 FIELD CONDITIONS

A. Permanent ventilators may not be used for ventilation during construction.

PART 2 PRODUCTS

2.01 POWER VENTILATORS - GENERAL

A. Static and Dynamically Balanced: AMCA 204 - Balance Quality and Vibration Levels for Fans.

B. Performance Ratings: Determined in accordance with AMCA 210 and bearing the AMCA Certified Rating Seal.

C. Sound Ratings: AMCA 301, tested to AMCA 300 and bearing AMCA Certified Sound Rating Seal.

D. Fabrication: Comply with AMCA 99.

E. Electrical Components: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

2.02 ROOF EXHAUSTERS

A. Manufacturers:
   1. Carnes, a division of Carnes Company Inc: www.carnes.com/#sle.
   2. Greenheck Fan Corporation: www.greenheck.com/#sle.
   3. PennBarry, Division of Air System Components: www.pennbarry.com/#sle.
   4. Twin City Fan & Blower; BCRD: www.tcf.com/#sle.

B. Fan Unit: V-belt or direct driven as indicated, with spun aluminum housing; resilient mounted motor; 1/2 inch mesh, 0.62 inch thick aluminum wire birdscreen; square base to suit roof curb with continuous curb gaskets.

C. Backdraft Damper: Gravity actuated, aluminum multiple blade construction, felt edged with offset hinge pin, nylon bearings, blades linked, and line voltage motor drive, power open, spring return.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Secure roof exhausters with cadmium plated steel lag screws to roof curb.

C. Extend ducts to roof exhausters into roof curb. Counterflash duct to roof opening.

D. Install backdraft dampers on inlet to roof and wall exhausters.

END OF SECTION

SECTION 233600
AIR TERMINAL UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Single-duct terminal units.
   1. Variable-volume units.

1.02 REFERENCE STANDARDS

A. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils; 2001, with Addendum (2011).

B. AHRI 880 (I-P) - Performance Rating of Air Terminals; 2017.

C. ASHRAE Std 130 - Laboratory Methods of Testing Air Terminal Units; 2016.

D. ASTM A492 - Standard Specification for Stainless Steel Rope Wire; 1995 (Reapproved 2013).

E. ASTM A603 - Standard Specification for Metallic-Coated Steel Structural Wire Rope; 2019.

F. ASTM C1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2019.

G. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

H. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.

1.03 SUBMITTALS

A. Product Data: Provide data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings that indicate airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements.

B. Manufacturer's Installation Instructions: Indicate support and hanging details, installation instructions, recommendations, and service clearances required.

C. Project Record Documents: Record actual locations of units and locations of access doors required for access of valving.

D. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant-volume regulators.

E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

1.05 WARRANTY

A. Provide five year manufacturer warranty for air terminal units.

PART 2 PRODUCTS

2.01 SINGLE-DUCT, VARIABLE-VOLUME UNITS

A. Manufacturers:
   1. Price Industries, Inc: www.priceindustries.com/#sle.
   2. Titus: www.titus-hvac.com

B. General:
   1. Factory-assembled, AHRI 880 (I-P) rated and bearing the AHRI seal, air volume control terminal with damper assembly, flow sensor, externally mounted volume controller, duct collars, and all required features.
   2. Control box bearing identification, including but not necessarily limited to nominal cfm, maximum and minimum factory-set airflow limits, coil type and coil (right or left hand) connection, where applicable.

C. Unit Casing:
   1. Minimum 22 gauge, 0.0299 inch galvanized steel.
      a. Casing leakage to meet ASHRAE Std 130.
   2. Air Inlet Collar: Provide round, suitable for standard flexible duct sizes.
   3. Unit Discharge: Rectangular, with slip-and-drive connections.
   4. Acceptable Liners:
      a. 1/2 inch thick, coated, fibrous-glass complying with ASTM C1071.
         1) Secure with adhesive.
         2) Coat edges exposed to airstream with NFPA 90A approved sealant.
         3) Cover liner with non-porous foil.
      b. Liner not to contain pentabrominated diphenyl ether (CAS #32534-81-9) or octabrominated diphenyl ether.

D. Damper Assembly:
   1. Heavy-gauge, galvanized steel, or extruded aluminum construction with solid steel, nickel-plated shaft pivoting on HDPE, self-lubricating bearings.
   2. Provide integral position indicator or alternative method for indicating damper position over full range of 90 degrees.
   3. Incorporate low leak damper blades for tight airflow shutoff.

E. Hot Water Heating Coil:
   1. Coil Casing: Minimum 22 gauge, 0.0299 inch galvanized steel, factory-installed on terminal discharge with rectangular outlet, duct connection type.
      a. Access Door: Gasketed and insulated located downstream of coils.
   2. Coil Fins: Aluminum or aluminum plated fins, mechanically-bonded to seamless copper tubes.
   3. Coil leak tested to minimum 350 psig.
   4. Base performance data on tests run in accordance with AHRI 410 and units to bear AHRI 410 label.

F. Controls:
   1. Terminal Unit Controls:
      a. Provide accessories for field interfaced controller including ball valve and thermostat.
      b. Factory ship DDC controller including airflow sensor, integral airflow transmitter, integral damper actuator, and duct-mounted temperature sensor.
      c. Sequence of Operation: Zone temperature control with airflow and coil discharge monitoring.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install the inlets of air terminal units and air flow sensors a minimum of four duct diameters from elbows, transitions, and duct takeoffs.

C. Provide ceiling access doors or locate units above easily removable ceiling components.

D. Support units individually from structure with wire rope complying with ASTM A492 and ASTM A603 in accordance with SMACNA (SRM). See Section 230548.

E. Do not support from ductwork.

F. Connect to ductwork in accordance with Section 233100.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot-Water Piping: In addition to requirements in Division 23 Section "Hydronic Piping," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

D. Connect ducts to air terminal units according to Division 23 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 26 Section "Grounding and Bonding."

F. Connect wiring according to Division 26 Section "Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
   2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.

END OF SECTION

SECTION 233700
AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Rectangular ceiling diffusers.

B. Registers/grilles:
   1. Ceiling-mounted, egg crate exhaust and return register/grilles.

C. Duct-mounted supply and return registers/louvers.

1.02 SUBMITTALS

A. See Division 01 for submittal procedures.

B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

1.03 QUALITY ASSURANCE

A. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.

PART 2 PRODUCTS

2.01 AIR DEVICE MANUFACTURERS

A. Krueger-HVAC: www.krueger-hvac.com/#sle.

B. Nailor

C. Metalaire, a brand of Metal Industries Inc: www.metalaire.com/#sle.

D. Price Industries: www.price-hvac.com/#sle.

E. Ruskin Company: www.ruskin.com/#sle.

F. Titus, a brand of Air Distribution Technologies: www.titus-hvac.com/#sle.

2.02 RECTANGULAR CEILING DIFFUSERS

A. Type: Provide square, stamped, plaque diffuser to discharge air in 360 degree, one way, two way, three way, and four way pattern with sectorizing baffles where indicated.

B. Connections: Round.

C. Frame: Provide surface mount, snap-in, inverted T-bar, and spline type. In plaster ceilings, provide plaster frame and ceiling frame.

D. Fabrication: Steel with baked enamel finish.

E. Color: As indicated on drawings.

F. Accessories: Provide removable core, sectorizing baffle, equalizing grid, and gaskets for surface mounted diffusers with damper adjustable from diffuser face.

2.03 CEILING EGG CRATE EXHAUST AND RETURN GRILLES

A. Type: Egg crate style face consisting of 1/2 by 1/2 by 1/2 inch grid core.

B. Fabrication: Grid core consists of aluminum with mill aluminum finish.

C. Color: As indicated on the drawings.

D. Frame: Channel lay-in frame for suspended grid ceilings. In plaster ceilings, provide plaster frame and ceiling frame.

E. Accessories: Provide integral, gang & face operated opposed blade damper and plaster frame.

F. Fire Rated Assembly: Provide UL Fire rated ceiling diffuser assembly, including radiation damper, where required by schedule.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.

C. Check location of outlets and inlets and make necessary adjustments in position to comply with architectural features, symmetry, and lighting arrangement.

D. Install diffusers to ductwork with air tight connection.

E. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

END OF SECTION

SECTION 235100
BREECHINGS, CHIMNEYS, AND STACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Double wall metal stacks.

1.02 SUBMITTALS

A. Product Data: Provide data indicating factory built chimneys, including dimensional details of components and flue caps, dimensions and weights, electrical characteristics and connection requirements.

1.03 QUALITY ASSURANCE

A. Designer Qualifications: Design stacks under direct supervision of a Professional Structural Engineer experienced in design of the type of work specified and licensed in the State in which the Project is located.

B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 BREECHINGS, CHIMNEYS, AND STACKS - GENERAL REQUIREMENTS

A. Regulatory Requirements:
1. Comply with applicable codes for installation of natural gas burning appliances and equipment.

2.02 DOUBLE WALL SPECIAL GAS VENTS

A. Provide double wall positive pressure special gas vents tested and listed to UL 1738 for use with natural gas or propane buring equipment that produce continuous flue-gas temperatures not above 55o deg. F, and suitable for use with Catagory I, II, III and IV Gas Burning Appliances

B. Fabricate with 1 inch minimum air space between walls. Construct inner jacket from AL29-4C stainless steel suitable for use with high-efficiency gas burning equiment, which produce excessive amounts of condensate within the vent. Construct outter jacket from type 430 stainless steel.

C. Accessories, UL labeled:
1. Ventilated Roof Thimble: consists of roof penetration, vent flashing with spacers and storm collar.
2. Exit Cone: Consists of inner cone, and outer jacket, to increase stack exit velocity 1.5 times.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install in accordance with NFPA 54.

C. Install breechings with minimum of joints. Align accurately at connections, with internal surfaces smooth.

D. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Division 07.

END OF SECTION

SECTION 235216
CONDENSING BOILERS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Manufactured units.

B. Boiler construction.

C. Boiler trim.

D. Fuel burning system.

E. Factory installed controls.

1.02 RELATED REQUIREMENTS

A. Section 230913 - Instrumentation and Control Devices for HVAC.

B. Section 232500 - HVAC Water Treatment.

C. Section 235100 - Breechings, Chimneys, and Stacks.

1.03 REFERENCE STANDARDS

A. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); Current Edition.

B. ANSI Z21.13 - American National Standard for Gas-Fired Low Pressure Steam and Hot Water Boilers; 2017, with Errata (2018).

C. ASHRAE Std 90.1 I-P - Energy Standard for Buildings Except Low-Rise Residential Buildings; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

D. ASME BPVC-IV - Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers; 2019.

E. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); Current Edition.

F. NFPA 54 - National Fuel Gas Code; 2018.

G. SCAQMD 1146.1 - Emissions of Oxides of Nitrogen from Small Industrial, Institutional, and Commercial Boilers, Steam Generators, and Process Heaters; 1990 (Amended 2018).

1.04 SUBMITTALS

A. See Division 01 - Administrative Requirements, for submittals procedures

B. Product Data: Provide data indicating general assembly, components, controls, safety controls, and wiring diagrams with electrical characteristics and connection requirements, and service connections.

C. Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.05 WARRANTY

A. See Divsion 01 - Closeout Submittals, for additional warranty requirements.

B. Provide a 10-year warranty for heat exchanger, pressure vessel, and condensate collection.

C. Provide a 5-year warranty for burner

D. Provide a minimum 18-month warranty for all other boiler components.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Natural Gas for Indoor Applications:
   1. Lochinvar LLC: www.lochinvar.com/#sle.
   2. Aerco: www.aerco.com.

B. Basis of Design: Aerco Benchmark
   1. The heating water system has been designed based on specific capacities and characteristics of equipment specified in this section and other sections.
   2. When substitution of a different manufacturer or model number is desired, submit sufficient information to demonstrate to Architect/Engineer that the substitute will have the same or better performance as that specified AND that the related equipment in the system will perform acceptably with the substitute.
   3. If the related equipment (including electrical, structural, and architectural) must be modified to perform acceptably with the substitute, the entity proposing the substitution is responsible for all additional costs due to re-design and provision of different related equipment

2.02 MANUFACTURED UNITS (FIRE TUBE)

A. Factory assembled, factory fire-tested, self-contained, readily transported unit ready for automatic operation except for connection of water, fuel, electrical, and vent services.

B. Unit: Metal membrane wall, water or fire tube, condensing boiler on integral structural steel frame base with integral fuel burning system, firing controls, boiler trim, insulation, and removable jacket, suitable for indoor application.

2.03 BOILER CONSTRUCTION (FIRE TUBE)

A. Comply with the minimum requirements of ASME BPVC-IV and ANSI Z21.13 for construction of boilers.

B. Assembly to bear the ASME "H" stamp and comply with the efficiency requirements of the latest edition of ASHRAE Std 90.1 I-P.

C. Required Directory Listings:
   1. AHRI Directory of Certified Product Performance - Air-Conditioning, Heating, and Refrigeration Institute (AHRI); current edition at www.ahrinet.org.
   2. NBBI Manufacturer and Repair Directory - The National Board of Boiler and Pressure Vessel Inspectors (NBBI); current edition at www.nationalboard.org.

D. Heat Exchanger: Construct with stainless steel alloy materials that are impervious to corrosion where subject to contact with corrosive condensables.

E. Pressure Vessel: Construct of welded steel constrution in accordance wiht ASME Section IV

F. Provide adequate tappings, observation ports, removable panels, and access doors for entry, cleaning, and inspection.

G. Insulate casing with insulation material, protected and covered by heavy-gauge metal jacket.

H. Factory apply boiler base and other components, that are subject to corrosion, with durable, acrylic, powder coated, or painted finish.

2.04 BOILER TRIM (FIRE TUBE)

A. ASME rated pressure relief valve.

B. Flow switch.

C. Electronic Low Water Cut-off: Complete with test light and manual reset button to automatically prevent firing operation whenever boiler water falls below safe level.

D. Temperature and pressure gauge.

E. Pressure Switches:
   1. High gas pressure.
   2. Low gas pressure.
   3. Air pressure.

F. Manual reset high limit.

2.05 FUEL BURNING SYSTEM (FIRE TUBE)

A. Provide forced draft automatic burner, integral to boiler, designed to burn natural gas, and maintain fuel-air ratios automatically.
   1. Blower Design: Statically and dynamically balanced to supply combustion air; direct connected to motor.
   2. Forced Draft Design: Mixes combustion air and gas to achieve 90 percent combustion efficiency.
   3. Combustion Air Filter: Protects fuel burning system from debris.

B. Gas Train: Plug valve, safety gas valve, gas-air ratio control valve, and pressure regulator controls air and gas mixture.

C. Emission of Oxides of Nitrogen Requirements: Comply with SCAQMD 1146.1 for natural gas fired system, as applicable.

D. Intakes: Combustion air intake capable of accepting free mechanical room air or direct outside air through a sealed intake pipe.

2.06 FACTORY INSTALLED CONTROLS (FIRE TUBE)

A. Option for internal or external (0-10) VDC control.

B. Temperature Controls:
   1. Automatic reset type to control fuel burning system on-off and firing rate to maintain temperature.
   2. Manual reset type to control fuel burning system to prevent boiler water temperature from exceeding safe system water temperature.
   3. Low-fire start time delay relay.

C. Electronic PI setpoint/modulation control system.

D. Microprocessor-based, fuel/air mixing controls.

2.07 BOILER ACCESSORIES (FIRE TUBE)

A. Safety Relief Valve:
   1. Size and Capacity:50psi
   2. Description: Fully enclosed steel spring with adjustable pressure range and positive shutoff; factory set and sealed.

B. Motorized Isolation Valves: Two way motorized isolaction valve with spring open return. Provide with end switch. Controlled by unit controller.

C. Condensate Neutralization Kit. Condensate neutralization kit sized to accommodate anticipated condesate production based on boiler input capacity.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install boiler and provide connection of natural gas service in accordance with requirements of NFPA 54 and applicable codes.

C. Install boiler on concrete housekeeping base, sized minimum of 4 inches high in accordance with Divisoin 03.

D. Coordinate factory installed controls with Section 230913.

E. Coordinate provisions for water treatment in accordance with Section 232500.

F. Pipe relief valves to nearest floor drain.

G. Pipe cooled condensate produced by the combustion process from the boiler condensate connection and/or flue stack with suitable piping material to neutralizer prior to discharging into nearest floor drain.

H. Provide for connection to electrical service in accordance with Division 26.

I. Vent combustion fumes in accordance with manufacturer's recommendations. Refer to Section 235100.

3.02 CLOSEOUT ACTIVITIES

A. See Division 01 - Closeout Submittals, for closeout submittals

B. See Division 01 - Demonstration and Training, for additional requirements.

C. Demonstrate proper operation of equipment to Owner's designated representative.

END OF SECTION

SECTION 237413
PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Packaged roof top unit

B. Unit controls.

C. Remote panel.

D. Roof mounting curb

1.02 RELATED REQUIREMENTS

A. Section 230913 - Instrumentation and Control Devices for HVAC: Installation of thermostats and other controls components.

B. Section 230593- Testing, Adjusting & Balancing for HVAC.

C. Division 26 for equipment Wiring: Installation and wiring of thermostats and other controls components; wiring from unit terminal strip to remote panel.

1.03 REFERENCE STANDARDS

A. AHRI 270 - Sound Performance Rating of Outdoor Unitary Equipment; 2015, with Addendum.

B. ASHRAE Std 135 - A Data Communication Protocol for Building Automation and Control Networks; 2020, with Errata and Amendments (2021).

C. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2021.

1.04 SUBMITTALS

A. Product Data: Provide capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

B. Shop Drawings: Indicate capacity and dimensions of manufactured products and assemblies required for this project. Indicate electrical service with electrical characteristics and connection requirements, and duct connections.

C. Manufacturer's Instructions: Indicate assembly, support details, connection requirements, and include start-up instructions.

D. Points list and sequence of operations: Sequence of operations should provide details for integrating with building management system.

E. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

F. Warranty: Submit manufacturer's warranty and ensure forms have been filled out in Owner's name and registered with manufacturer.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect units from physical damage by storing off site until roof mounting curbs are in place, ready for immediate installation of units.

1.07 WARRANTY

A. Provide a five year warranty to include coverage for refrigeration compressors.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Aaon

2.02 AIR CONDITIONING UNITS

A. General: Roof mounted units having hot water coils.

B. Description: Self-contained, packaged, factory assembled and prewired, consisting of cabinet and frame, supply fan, exhaust fan, water heating coil, controls and airflow monitoring station.

2.03 FABRICATION

A. Cabinet: NEMA3R enclousure, Steel with baked enamel finish, including access doors with piano hinges and locking handle. Structural members shall be minimum 18 gage, with access doors or panels of minimum 20 gage.

B. Hinged and latched access doors in each section.

C. Insulation: R-13 rigid foam insulation in cabinet walls and doors.

D. Supply and Exhaust Fan: Forward curved centrifugal typsupply fan backward inclined direct drive, resiliently mounted with V-belt drive or direct drive, outside air flow measuring station, variable frequency drive motors, inverter ready, and rubber isolated hinge mounted premium efficiency motor or direct drive as indicated. Isolate complete fan assembly.

E. Air Filters: MERV 8, 2 inch.

F. Provide factory disconnect and service outlet that is powered even when unit disconnect is off.

G. Adapt a curb.

2.04 COIL SECTION

A. Casing: Provide access to both sides of coils. Enclose coils with headers and return bends exposed outside casing. Slide coils into casing through removable end panel with blank off sheets and sealing collars at connection penetrations.

B. Air Coils: Certify capacities, pressure drops, and selection procedures in accordance with AHRI 410 for 30% propylene glycol.

C. Fabrication:
   1. Tubes: 5/8 inch OD seamless copper expanded into fins, brazed joints.
   2. Fins: Aluminum.
   3. Casing: Die formed channel frame of galvanized steel.

D. Water Heating Coils:
   1. Headers: Cast iron, seamless copper tube, or prime coated steel pipe with brazed joints.
   2. Configuration: Drainable, with threaded plugs for drain and vent; serpentine type with return bends on smaller sizes and return headers on larger sizes.

2.05 MIXED AIR CASING

A. Dampers: Provide outside, return, and relief damper are barometric and control package to automatically vary outside air quantity. Outside air damper to fall to closed position.

B. Gaskets: Provide tight fitting dampers with edge gaskets.

C. Damper Operator: 24 volt with gear train sealed in oil.

D. 100% Outside Air Economizer: Outside air damper, and exhaust air damper each sized for the full rated flow of the unit. Outside air flow measuring satations.

2.06 OPERATING CONTROLS

A. Controls shall be stripped to refrigeration controls. Temperature controls contractor to provide all controls for unit- field installed.

B. BAS, SCADA, or other Integrated Automation Link: ASHRAE Std 135, BACnet MS/TP.

C. Control Valves: Field-installed, modulating, ball type with position tracking; see Section 253519.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

3.02 SYSTEM STARTUP

A. Prepare and start equipment. Adjust for proper operation.

B. Manufacturer trained start up.

3.03 CLOSEOUT ACTIVITIES

A. Demonstrate operation to Owner's maintenance personnel.

3.04 MAINTENANCE

A. See Division 01 for additional requirements relating to maintenance service.

B. Include maintenance items as outlined in manufacturer's operating and maintenance data, including 2 filters per unit for owner stock.

END OF SECTION

SECTION 238200
CONVECTION HEATING AND COOLING UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Hydronic cabinet unit heaters.

1.02 RELATED REQUIREMENTS

A. Section 232113 - Hydronic Piping.

B. Section 232114 - Hydronic Specialties.

1.03 SUBMITTALS

A. Product Data: Provide typical catalog of information including arrangements.

B. Manufacturer's Instructions: Indicate installation instructions and recommendations.

C. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listings.

D. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

PART 2 PRODUCTS

2.01 HYDRONIC CABINET UNIT HEATERS

A. Manufacturers:
1. Modine Manufacturing Company: www.modineHVAC.com/#sle.
2. Trane Technologies, PLC: www.trane.com/#sle.

B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to Authority Having Jurisdiction as suitable for the purpose indicated.

C. Coils:
1. Evenly spaced aluminum fins mechanically bonded to copper tubes.

D. Cabinet: Minimum 16 gauge, 0.0598 inch thick sheet steel front panel with exposed corners and edges rounded, easily removed panels, glass fiber insulation, integral air outlet, and inlet grilles.

E. Finish: Factory applied baked primer coat on visible surfaces of enclosure or cabinet.

F. Fans: Centrifugal forward-curved double-width wheels, statically and dynamically balanced, direct driven.

G. Motor: Tap wound multiple speed permanent split capacitor with sleeve bearings, resiliently mounted.

H. Thermostatic Controls: Low voltage, electromechanical thermostat.

I. Control: Factory wired, solid state, infinite speed control, located in cabinet.

J. Filter: Easily removed, 1 inch thick glass fiber throw-away type, located to filter air before coil.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces are suitable for installation.

B. Verify that field measurements are as indicated on drawings.

3.02 INSTALLATION

A. Install in accordance with manufacturer's recommendations.

B. Install equipment exposed to finished areas after walls and ceilings are finished and painted.

C. Do not damage equipment or finishes.

D. Cabinet Unit Heaters:
   1. Install as indicated.
   2. Coordinate to ensure correct recess size for recessed units.

3.03 CLEANING

A. After construction and painting is completed, clean exposed surfaces of units.

B. Vacuum clean coils and inside of units.

C. Touch-up marred or scratched surfaces of factory-finished cabinets using finish materials furnished by the manufacturer.

END OF SECTION

SECTION 26 05 00
COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes

1. Electrical equipment coordination and installation.
2. Common electrical installation requirements.

1.03 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. Such that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

1.04 ELECTRICAL WIRING AND SAFETY DEVICE DELINEATION OF RESPONSIBILITIES

A. Unless otherwise indicated, all HVAC equipment motors and controls shall be furnished, set in place, and wired in accordance with the following schedule: MD = HVAC Division, ED = Electrical Division, TD = Temperature Control Division, I = Installer of equipment requiring electrical service.

B. Note: If Temperature Control Division is a subcontract to the HVAC Contractor, both MD and TD shall fall under the responsibility of MD. If no Temperature Control Contractor is under contract, MD shall assume all Temperature Control responsibilities.

C. Coordinate with Division 22 and Division 23 contractor within 30 days after award of contract to obtain complete summary list of all HVAC and Plumbing equipment requiring electric power. This list shall summarize equipment power loads/ line voltage control requirements, quantities, and location of equipment and connection points. The list shall clearly identify specific HVAC, Plumbing, and controls equipment that shall operate on emergency or standby power.

PART 2 - PRODUCT

	Furnished Under	Set In Place or Mounted Under	Power Wired & Connected Under	Control Wired & Connected Under
1. Other Equipment Motors/Starters	I	I	ED	I
2. Plumbing Equipment Motors	PD	PD	ED	TD
3. HVAC Equipment Motors	MD	MD	ED	TD

	Furnished Under	Set In Place or Mounted Under	Power Wired & Connected Under	Control Wired & Connected Under
4. HVAC Magnetic Motor Starters, VFD's	MD	MD	ED	TD
5. Control Wiring Regardless of Voltage	TD	TD	TD See footnote 1	TD
6. Control Components: Control Relays, Thermostats, Control Transformers, EP, PE Switches	TD	TD	TD See footnote 1	TD
7. Temperature Control Panels, Time Clocks, Controllers	TD	TD	TD See footnote 1	TD
8. Valve and Damper Motors and Actuators	TD	TD	TD See footnote 1	TD
9. Control Valves, Solenoid Valves	TD	MD	--	TD
10. Control Dampers Integral with a Fan Unit	MD	MD	--	--
11. Control Dampers (duct mounted)	TD	MD	--	TD
12. Thermowells in Piping	TD	MD	--	--
13. Fire Protection (Exterior Horn & Light)	FD	ED	ED	ED
14. Fire Protection (Tamper & Flow Switch)	FD	FD	ED	ED See footnote 3
15. Smoke Duct Detectors (including relays)	ED See footnote 3	MD See footnote 3	ED See footnote 4	ED See footnote 3
16. Fire and Smoke Dampers	MD	MD	ED	ED See footnote 2
17. Pushbutton Stations and Pilot Lights	MD	MD	ED	TD See footnote 4
18. Manual Operating Switches	MD	MD	ED	-- See footnote 5
19. Multi-speed Switches (not integral with Equipment served)	MD	MD	ED	-- See footnote 5
20. Fused and Unfused Disconnect Switches & Thermal Overload Switches	ED See footnote 6	ED See footnote 6	ED	--
21. Contactors	ED	ED	ED	ED
22. Temporary Heating Connection	MD	MD	ED	TD
23. Water Heater Controls	PD	PD	TD See footnote 1	TD
24. Boiler Controls, Boiler Burner Control Panels Internally Wired	MD	MD	TD See footnote 1	TD

	Furnished Under	Set In Place or Mounted Under	Power Wired & Connected Under	Control Wired & Connected Under
25. Remote Disconnect Switches for Boiler (Heating, Domestic HW & Pool Heat) Controls per ASME-CSD-1.	TD	TD See footnote 7	TD See footnote 8	TD

1. Footnote 1: It is the intention of this specification for all conduit and wiring which connects to control equipment or provides controls to HVAC equipment to be provided by the Temperature Control Contractor. Other portions of the specification which may be in conflict with this concept shall be brought to the attention of the engineer for clarification prior to bidding the project. The ED shall provide line voltage wiring conduit and junction boxes for the express purpose of temperature controls. It shall be the responsibility of the Temperature Control Contractor to coordinate the location of the junction boxes (if not otherwise shown on the Electrical Drawings) and to utilize these junction boxes for temperature control wiring. The Temperature Control Contractor shall extend line and/or low voltage wiring from junction boxes to all HVAC and control components which require control wiring.
2. Footnote 2: Wiring from the fire alarm electrical contacts to fire alarm system control panel by ED; all HVAC/Plumbing equipment control function wiring by TD. ED to coordinate locations of electrical contact with MD. MD to coordinate locations of duct smoke detectors with ED.
3. Footnote 3: MD shall assist in locating the detectors, but ED shall verify that the installation meets the manufacturer's installation guidelines, and is responsible for correctly ordering the smoke detectors. MD shall mount the detectors in a manner directed by ED according to manufacturer's recommendation. If the detector is used for operation of a smoke/fire damper, the control wiring will be by ED. If the unit is used for fan shutdown, the fire alarm functions will be by ED and the wiring to the starter or VFD for a direct shutdown will be by MD, typically by the TD. Any signal required for the sequence of operation shall be coordinated between MD and ED, with ED providing a point of connection and MD responsible for the remainder of the installation.
4. Footnote 4: For connection to auxiliary contacts if required.
5. Footnote 5: Device is used in the power wiring circuit to the equipment. Control functions do not exist.
6. Footnote 6: Unless furnished with equipment.
7. Delete Footnotes 7 and 8 below if you delete #21 Remote Disconnect Switches for Boiler Controls in table above.
8. Footnote 7: A manually operated remote shutdown switch(es) shall be located just outside the boiler room door and marked for easy identification. Consideration should be given to the type and location of the switch to safeguard against tampering. If the boiler room door is on the building exterior, the switch should be located just inside the door. If there is more than one door to the boiler room, there should be a switch located at each door. The emergency shutdown switch shall be wired to the boiler safety circuit relay and shall disconnect all power to the boiler safety circuit.
9. Footnote 8: TD shall provide 24V to emergency power off switches.

PART 3 - EXECUTION

3.01 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

END OF SECTION

SECTION 26 05 19

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Copper building wire rated 600 V or less.

2. Connectors, splices, and terminations rated 600 V and less.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 DEFINITIONS

A. RoHS: Restriction of Hazardous Substances.

B. VFC: Variable-frequency controller.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 – PRODUCTS

2.01 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

2. RoHS compliant.

3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

D. Conductor Insulation

1. Type THHN and Type THWN-2: Comply with UL 83.

2. Type XHHW-2: Comply with UL 44.

E. Note: Use of Armored Cable, MC Cable, ENT/NM, and Modular Wire is prohibited, unless specifically authorized on a case by case basis by Jefferson County School District.

2.02 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

C. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.

1. Material: Copper.

2. Type: One hole with standard barrels.

3. Termination: Compression.

PART 3 – EXECUTION

3.01 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.

D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.02 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

E. Exposed Branch Circuits, Including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.

H. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

I. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.03 INSTALLATION OF CONDUCTORS AND CABLES

A. District Standards – General Installation:

1. For each branch circuit that requires a neutral, install a dedicated neutral conductor within that branch circuit.

2. VD% less than 3% total between service and end use (outlets).

3. Use no wire smaller than 12 AWG for power and lighting circuits and not smaller than 14 AWG for control wiring.

4. Use 10 AWG conductors for 20 ampere, 120 volt branch circuit home runs longer than 75 feet and for 20 ampere, 277 volt branch circuit home runs longer than 150 feet.

5. Make conductor lengths equal for parallel circuits.

B. District Standards – Wiring in Raceways:

1. Completely and thoroughly swab raceway system before installing conductors.

2. Pull all conductors into a raceway at the same time. Use UL-listed wire pulling lubricant rated for - 20ºF for pulling 4 AWG and larger wires.

3. Install wire only in complete raceways after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. District Standards - Support of cables above accessible ceilings:

1. Support cables above accessible ceilings at four to six foot maximum intervals

2. Do not rest on ceiling tiles.

3. Use hangar rods to support cables from structure.

4. See Data, Communications, and Alarm Diagram for support details.

D. District Standards – Field Quality Control:

1. Control and signal cables passing through fire rated construction: In sleeves; conform to Technical Guideline 07 80 00 Fire and Smoke Protection.

2. Provide sleeves for fire alarm, paging, data, telecommunications, and CATV.

E. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

F. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

G. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

H. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

I. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

J. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

3.04 CONNECTIONS

A. District Standards:

1. Splice only in accessible junction or outlet boxes.

2. Use insulated spring wire connectors with plastic caps for 10 AWG and smaller.

3. Use U.L. listed connectors (Ilsco Clear Tap Products, or equal) for wire splices and taps, Ilsco Clear Tap or Burndy Hi Press #8-500 KCMIL

4. Tape or heat shrink uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of the conductor.

5. Terminate spare conductors with electrical tape.

6. Use only corrosion resistant connectors listed for terminations in wet locations.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

C. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

D. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.05 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.06 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.07 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.08 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each of the following visual and electrical tests:

a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.

b. Test bolted connections for high resistance using one of the following:

1) A low-resistance ohmmeter.

2) Calibrated torque wrench.

3) Thermographic survey.

c. Inspect compression-applied connectors for correct cable match and indentation.

d. Inspect for correct identification.

e. Inspect cable jacket and condition.

f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.

g. Continuity test on each conductor and cable.

h. Uniform resistance of parallel conductors.

3. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.

    a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

    b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Cables will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports to record the following:

1. Procedures used.

2. Results that comply with requirements.

3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 26 05 26

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
2. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:
    a. Grounding arrangements and connections for separately derived systems.

PART 2 PRODUCTS

2.01 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.02 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B3.
2. Stranded Conductors: ASTM B8.
3. Tinned Conductors: ASTM B33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.03 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

I. Straps: Solid copper, cast-bronze clamp. Rated for 600 A.

J. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

K. Water Pipe Clamps:

1. Mechanical type, two pieces with zinc-plated bolts.
    a. Material: Tin-plated aluminum.
    b. Listed for direct burial.

2.04 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m).

PART 3 EXECUTION

3.01 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Conductors: Green-colored insulation with continuous yellow stripe.

C. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.

E. Conductor Terminations and Connections:
    1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
    2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
    3. Connections to Ground Rods at Test Wells: Bolted connectors.
    4. Connections to Structural Steel: Welded connectors.

3.02 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.03 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
    1. Feeders and branch circuits.
    2. Lighting circuits.
    3. Receptacle circuits.
    4. Single-phase motor and appliance branch circuits.
    5. Three-phase motor and appliance branch circuits.
    6. Flexible raceway runs.
B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

3.04 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
B. District Standards:
    1. Provide a separate, insulated equipment grounding conductor in all feeder and branch circuits. Feeders require steel ground bushing, all ends.
        a. Terminate each end on a grounding lug, bus or bushing.
        b. Ground to all boxes unless otherwise specified
    2. Use conduit grounding bushings on feeder circuits, flex conduits to transformers, services, and panels.
        a. Motors:

1) Both ends all splice and pull boxes
2) Provide steel bonding bushings on feeders all ends, including motors, motor controls, disconnect for TVSS and VFD drives.

3. Communications Grounding Bonding conductors: Use minimum 4 AWG copper conductor; or larger where indicated on Drawings.
    a. Insulated from building
    b. Terminate to approved grounding bus
    c. See Data, Communications, and Alarm Diagram

C. All conduit and raceways shall contain an insulated ground wire sized per NEC 250.122.

D. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.
    1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
    2. Use exothermic welds for all below-grade connections.
    3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
    1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
    2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
    3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:
    1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
    2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
    3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.

H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet (18 m) apart.

I. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Prepare test and inspection reports.

END OF SECTION

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SECTION 26 05 29

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Steel slotted support systems.
2. Conduit and cable support devices.
3. Support for conductors in vertical conduit.
4. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
    a. Slotted support systems, hardware, and accessories.
    b. Clamps.
    c. Hangers.
    d. Sockets.
    e. Eye nuts.
    f. Fasteners.
    g. Anchors.
    h. Saddles.
    i. Brackets.

2. Include rated capacities and furnished specialties and accessories.

B. Shop Drawings: For fabrication and installation details for electrical hangers and support systems.

1. Hangers. Include product data for components.

2. Slotted support systems.

3. Equipment supports.

1.04 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.

PART 2 PRODUCTS

2.01 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-(10-mm-) diameter holes at a maximum of 8 inches (200 mm) o.c. in at least one surface.

1. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.

2. Material for Channel, Fittings, and Accessories: Galvanized steel.

3. Channel Width: Selected for applicable load criteria.

4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

5. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. District Standards - Conduit and Cable Support Devices:

1. Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

2. Galvanized straps, lay-in adjustable hangers, clevis hangers or bolted split stamped galvanized hangers

3. Perforated pipe strap is prohibited.

4. Wire of any type is prohibited.

5. Arrange to prevent distortion or misalignment from wire pulling.

C. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

D. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.

E. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325 (Grade A325M).

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.02 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 EXECUTION

3.01 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:

1. NECA 1.

2. NECA 101

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

    1. Secure raceways and cables to these supports with two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.02 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, according to NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

    1. To Wood: Fasten with lag screws or through bolts.

    2. To New Concrete: Bolt to concrete inserts.

    3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

    4. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

    5. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.

    6. To Light Steel: Sheet metal screws.

    7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate.

E. District Standards – Securing Equipment:

1. Secure transformers and switchgear to floor or slab. Install approved vibration isolators on transformer mounting hardware.

2. Under distribution switchboards, install free-standing electrical equipment on 4-inch concrete pads.

3. Install surface-mounted cabinets, panelboards, and transformers with minimum of four anchors.

4. Align tops of all adjacent cabinets.

5. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

F. District Standards - Conduit and Cable Support Devices – Spacing:

1. Per NEC

2. In no case more than 2' from panels, boxes, conduit bodies

3. 8 feet-0 inches O.C.

G. District Standards – Fasteners:

1. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors or preset inserts.

2. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls.

3. Use expansion anchors or preset inserts in solid masonry walls.

4. Use self-drilling anchors or expansion anchor on concrete surfaces.

5. Use sheet metal screws in sheet metal studs.

6. Use hexagon head bolts with spring lock washers under all nuts.

7. Powder-actuated anchors are prohibited without specific written permission.

H. District Standards - Quality Control:

1. Fasten supports directly to structure.

    a. Do not fasten supports to piping, ductwork, mechanical equipment, conduit, or ceiling system suspension wires or wire of any type.

2. Drilling or other modification of structural steel members is prohibited without specific written permission from the structural engineer.

3. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.03 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.04 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION

SECTION 26 05 33

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Surface raceways.
4. Boxes, enclosures, and cabinets.
5. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.

C. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

B. IMC: Intermediate metal conduit.

1.04 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:

1. Structural members in paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.

B. Source quality-control reports.

PART 2 PRODUCTS

2.01 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. GRC: Comply with ANSI C80.1 and UL 6.

3. IMC: Comply with ANSI C80.6 and UL 1242.

4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

    a. Comply with NEMA RN 1.

    b. Coating Thickness: 0.040 inch (1 mm), minimum.

5. EMT: Comply with ANSI C80.3 and UL 797.

6. FMC: Comply with UL 1; zinc-coated steel.

7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Comply with NEMA FB 1 and UL 514B.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fittings, General: Listed and labeled for type of conduit, location, and use.

4. Coordinate "Conduit Fittings for Hazardous (Classified) Locations" Subparagraph below with Drawings.

5. Fittings for EMT:

    a. Material: Steel.

    b. Type: Compression.

6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.02 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. ENT: Comply with NEMA TC 13 and UL 1653.

3. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

4. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

1. Fittings, General: Listed and labeled for type of conduit, location, and use.

2. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

    a. Fittings for LFNC: Comply with UL 514B.

3. Solvents and Adhesives: As recommended by conduit manufacturer.

2.03 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.

C. District Standards – Surface Metal Raceways:

1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1.

    a. Carlton

    b. Hubbell

    c. IsoDuct

    d. Panduit

    e. Square D

    f. Walker

    g. Wiremold

2. System of sheet metal channel with fitted cover suitable for use as surface metal raceway
3. Couplings, elbows and connectors designed for used with the raceway system
4. Boxes and Extension Rings designed for use with the raceway systems
    a. Extension boxes and/or rings not allowed on new work
5. Use flat head screws to fasten channel to surfaces
    a. Option: Use suitable clips and straps
6. Use insulating bushings and inserts at connections to outlets and corner fittings
7. Maintain grounding continuity between raceway components
8. Preferred location: below the work surface or deck tops

2.04 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. District Standards - Pull and Junction Boxes:

1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1.
    a. Appleton Electric
    b. Bowers
    c. Carlton
    d. Lew Electric
    e. National Electrical Products
    f. Raco
    g. Steel City
2. Sheet Metal Boxes less than 24 inches: ANSI/NEMA OS 1; galvanized steel.
3. Sheet Metal Boxes Larger than 24 inches in any dimension: Hinged enclosure in accordance with Section 26 27 16.
4. Cast Metal Boxes for Outdoor and Wet Location Installations: NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as rain tight. Cast aluminum box and cover with ground flange, neoprene gasket and stainless steel cover screws.
    a. Shall not be used at vehicle traffic areas

5. Fiberglass Handholes for Underground Installations:
    a. Die-molded with pre-cut 6 x 6 inch cable entrance at center bottom of each side
    b. Fiberglass weatherproof cover with non-skid finish
    c. Traffic Rated
    d. 20k rated weight minimum.
    e. Shall not be used at vehicle traffic areas such as parking lots and drives.
6. Locate and install boxes above accessible ceilings or in unfinished areas to allow access.
    a. Where installation is inaccessible, coordinate locations and size of required access doors.
    b. In inaccessible ceiling areas, position outlets and junction boxes within 6 inches of recessed luminaire, to be accessible through luminaire ceiling opening.
7. Locate and install boxes to maintain headroom and to present a neat appearance.
8. Support pull and junction boxes independent of conduit.

C. District Standards - Floor Boxes:
1. Restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1.
    a. Appleton Electric
    b. Bowers
    c. Hubbell
    d. Lew Electric
    e. Raceway Components Inc.
    f. Rotco Inc.
    g. Steel City
    h. Walker
2. The use of floor boxes is discouraged. Consider other options first.
    a. Coordinate with District Project Manager

D. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

E. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

J. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep) .

K. Gangable boxes are allowed.

L. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

M. Cabinets:

1. NEMA 250, Type 1 galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.05 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

1. Standard: Comply with SCTE 77.

2. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

5. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

6. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.

1. Standard: Comply with SCTE 77.

2. Color of Frame and Cover: Gray.

3. First option in "Configuration" Subparagraph below facilitates bottom conduit entry. Second option may be provided by a separate slab placed in the excavation under an open-bottom enclosure; third option is obtained by molding or fabricating the bottom integrally with the body of unit.

4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

8. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 EXECUTION

3.01 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC or IMC.

2. Concealed Conduit, Aboveground: GRC.

3. Underground Conduit:

    a. Within 5 feet of foundation wall or in or under concrete slab: GRC

    b. Beyond 5feet of foundation wall: EPC-80-PVC

    c. 90 degree plastic coated rigid steel conduit where it protrudes out of the earth. Transition between PVC and metal conduit below grade or within slab. Must use PVC coated GRC 90's to transition above grade.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

6. Restrictions

    a. Attachment of conduit and tubing to any exterior part of the building envelope is prohibited without the approval of Jefferson County School District, R-1 and compliance with Division 07 of these Technical Guidelines.

    b. Horizontal conduit runs within above grade concrete slabs are prohibited.

    c. Roof penetrations are prohibited unless coordinated and detailed in strict compliance with Division 07.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT

2. PVC Schedule 80 is acceptable for under slab home runs and branch circuits.

3. Exposed, Not Subject to Severe Physical Damage: EMT.

4. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following locations below 8'-0" AFF:

    a. Mechanical / boiler rooms.

    b. Gymnasiums.

5. Concealed in Ceilings and Interior Walls and Partitions: EMT.

6. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

7. Damp or Wet Locations: GRC.

8. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.

4. High quality compression is required on surface work in kitchens, greenhouses, and other areas where waterproof fittings are required by NEC.

5. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface raceways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F (49 deg C).

3.02 INSTALLATION

A. District Standards - Outlet Boxes:

1. Do not install boxes back-to-back in walls.

a. Provide minimum 6 inch separation; (1) 24 inch separation in acoustic or fire-rated walls.

2. Locate boxes in masonry walls to require cutting of masonry unit corner only.

3. Provide knockout closures for unused openings.

4. Support boxes independently of conduit except for cast boxes that are connected to two rigid metal conduits, both supported within 12 inches of box.

5. Use multiple-gang boxes where more than one devices are mounted together; do not use sectional boxes.

6. Provide barriers to separate wiring of different voltage systems.

7. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness.

a. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.

8. Provide cast outlet boxes in exterior locations exposed to the weather and wet interior locations.

9. Exposed boxes in kitchens and shops:

    a. Provide bell type boxes with threaded openings.

B. District Standards - Underground Pull Boxes in vehicle traffic areas:

1. Restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1 :

    a. Amcor 3 x 3 precast PB 3030-30; #0300720:

        1. Pre-cast concrete open-bottom

        2. Steel traffic rated lid stamped “ELECTRICAL”.

        3. Bonded to equipment ground

        4. Traffic Rated to 20K minimum.

    b. Approved equivalent.

C. District Standards - Exterior Pedestals:

1. Concrete pad mounted electrical pedestals for exterior use

    a. At temporary classroom buildings

    b. Milbank, or equivalent

    c. Weathertight

D. District Standards - Rigid Metal Conduit and Fittings:

1. Rigid Steel Conduit:

    a. ANSI C80.1 galvanized

2. PVC Externally Coated Conduit:

    a. NEMA RN 1 Rigid steel conduit with external 40 mil PVC coating and internal galvanized surface

3. Fittings and Conduit Bodies:

    a. ANSI/NEMA FFB 1

    b. Threaded type, material to match conduit

E. District Standards - Intermediate Metal Conduit and Fittings:

1. Conduit: Galvanized steel
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1; Threaded type, material to match conduit

F. District Standards - Electrical Metallic Tubing and Fittings:
   1. EMT:
      a. ANSI C80.3 Galvanized tubing
   2. Fittings:
      a. ANSI/NEMA FB 1
      b. High quality, insulated throat, steel set screw
      c. Die cast fittings are prohibited
   3. Steel Compression Fittings:
      a. High quality compression is required on surface work in kitchens, greenhouses, and other areas where waterproof fittings are required by NEC
   4. Conduit Bodies: Aluminum, steel or malleable iron
      a. PVC is prohibited

G. District Standards - Flexible Metal Conduit and Fittings (Armored Cable):
   1. Use only at fixture whips and part of a listed assembly.
   2. All other locations prohibited.
   3. Conduit:
      a. Steel
   4. Fittings and Conduit Bodies:
      a. ANSI/NEMA FB 1
      b. Material to match conduit
   5. Length:
      a. 6 feet maximum except where fished or approved by NEC and Jefferson County School District, R-1.

H. District Standards - Liquid Tight Flexible Metal Conduit and Fittings:
   1. Conduit:
      a. Flexible metal conduit with PVC jacket

2. Fittings and Conduit Bodies: ANSI/NEMA FFB 1; waterproof material to match conduit.

3. 6 feet maximum lengths or as required by NEC.

I. District Standards - Non-Metallic Conduit and Fittings:

1. Shall not be used above grade.

2. Conduit:

a. NEMA TC 2; Schedule 40 PVC

3. Fittings and Conduit Bodies: NEMA TC 3

4. Prohibited for exposed or concealed applications in stud and masonry walls or ceiling plenum.

5. Wipe plastic conduit clean and dry before joining

6. Apply full even coat of cement to entire area that will be inserted into the fitting

7. Cure joint 20 minutes minimum

8. Transition between PVC and metal conduit below grade or within slab. Must use PVC coated GRC 90's to transition above grade.

9. PVC expansion couplings shall be used at transition between grade and building surface, and as required by NEC.

J. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

K. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

L. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

M. Do not fasten conduits onto the bottom side of a metal deck roof.

N. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

O. Complete raceway installation before starting conductor installation.

P. Arrange stub-ups so curved portions of bends are not visible above finished slab.

Q. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

R. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

S. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

T. Support conduit within 12 inches (300 mm) of enclosures to which attached.

U. Stub-Ups to Above Recessed Ceilings:

    1. Use EMT, IMC, or RMC for raceways.

    2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

V. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

W. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

X. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Y. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

Z. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

AA. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

BB. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

CC. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

DD. Surface Raceways:

    1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

    2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

EE. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to NFPA 70.

FF. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Conduit extending from interior to exterior of building.

4. Conduit extending into pressurized duct and equipment.

5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

6. Where otherwise required by NFPA 70.

GG. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

HH. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F (17 deg C) and that has straight-run length that exceeds 25 feet (7.6 m). Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

    a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C temperature change.

    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C temperature change.

    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

    d. Formula in first subparagraph below provides about 15 percent safety factor (extra expansion-contraction capability).

    e. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of

length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

f. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

g. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

II. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches (915 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

JJ. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

KK. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

LL. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

MM. Locate boxes so that cover or plate will not span different building finishes.

NN. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

OO. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

PP. Set metal floor boxes level and flush with finished floor surface.

3.03 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to

provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

    a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

    b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.04 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install handholes with bottom below frost line.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.05 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.06 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.07 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

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SECTION 26 05 44

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 PRODUCTS

2.01 SLEEVES

B. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

C. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

D. PVC sleeves in "PVC-Pipe Sleeves" and "Molded-PVC Sleeves" paragraphs below may be prohibited by authorities having jurisdiction.

E. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.

F. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

G. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

H. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.02 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
2. Pressure Plates: Carbon steel.
3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.03 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

2.04 GROUT

B. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

C. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

D. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

E. Packaging: Premixed and factory packaged.

2.05 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
2. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 EXECUTION

3.01SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using [steel] [cast-iron] pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.02 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

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SECTION 26 05 53

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. General Labeling requirements
2. Color and legend requirements for raceways, conductors, and warning labels and signs.
3. Labels.
4. Bands and tubes.
5. Tapes and stencils.
6. Tags.
7. Signs.
8. Cable ties.
9. Paint for identification.
10. Fasteners for labels and signs.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 70.

B. Retain first paragraph below if danger, caution, or safety instruction signs (including arc-flash warning labels) are to be specified.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

H. Differential values in "Temperature Change" Subparagraph below (for aluminum in particular) are suitable for most of the United States.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.02 GENERAL LABELING REQUIREMENTS

A. District Standards

1. Fonts for all identification

a. Sans Serif typeface such as Helvetica

2. Color code – Printed Self-Adhesive Labels:

a. Black characters on white or clear background for “Normal”

b. White characters on read background for “Emergency” and fire alarm devices

c. White characters on green background for “Ground”

3. Nameplates

a. Mechanically mounted – riveted

b. White letters on black background

c. Provide engraved nylon trim plates for gym lighting corridor and boxes three (3) gang and larger.

4. Provide on all large equipment

a. Distribution and control equipment

1. Engraved three-layer laminated plastic

2. UV Resistant

3. Identify equipment and loads served.

4. 1/8 inch lettering for individual switches and loads served
5. 1/4 inch lettering for distribution and control equipment.

b. Panelboards and Switchboards:
1. 1/4 inch lettering to identify equipment designation
2. 1/8 inch lettering to identify voltage rating and source.

c. Individual Circuit Breakers and Switches in Panelboards and Switchboards:
1. 1/8 inch lettering to identify circuit and load served, including location.

d. Individual Circuit Breakers, Enclosed Disconnect Switches, and Motor Starters:
1. 1/8 inch lettering to identify load served and circuit designation.

e. Transformers:
1. 1/4 inch lettering to identify equipment designation.
2. 1/8 inch lettering to identify primary and secondary voltages, primary source, and secondary load and location.

f. Main Grounds:
1. 1/4 inch lettering "Do Not Disconnect".
2. 1/4 inch lettering to identify type of ground.

5. Printed, Laminated Labels:
a. Self-adhesive, thermal transfer tape
b. Minimum 3/8 inch high characters
c. Colors as noted in color code above
d. Use only for identification of individual wall switches and receptacles, control device stations.
e. Locate tape on the front side of the cover plate and with indelible ink on the back of the cover plate and with indelible ink on the device/junction box.
f. Electrical Disconnects above ceilings and other semi-concealed spaces.

6. Wire and Cable Markers:
a. Permanently printed split sleeve tube type adhesive backed circumferential:
b. Brady, or approved equivalent.

7. Degrease and clean surfaces to receive nameplates and tape labels.

8. Install nameplates and tape labels parallel to equipment lines.

    a. Secure nameplates to equipment fronts using screws, rivets.

    b. Secure nameplate to inside face of recessed panelboard doors in finished locations. Label “Grounding Electrode Conductor” and “Main Bonding Jumper” with engraved tags.

9. Wire Identification

    a. Provide wire markers on each conductor in panelboard gutters, pull boxes, outlet and junction boxes, and at load connection.

    b. Identify with branch circuit or feeder number as indicated on equipment manufacturer’s shop drawings for control wiring.

10. Junction Box and Pull Box Identification

    a. Use indelible black marker to inscribe circuit or bus, switch numbers and source panel on the outside of each junction and pullbox cover.

11. Systems Identification

    a. Arc flash labeling on all equipment including disconnects. Per NFPA 70E

    b. Telephone:

        1. Identify telephone raceways with the label “TELEPHONE” on pull and junction boxes and conduit at the termination points.

        2. Identify Telephone Termination Backboard with the legend “TELEPHONE” on pull and junction boxes and conduit at the termination points.

    c. Television:

        1. Identify television raceways with the label “TELEVISION” on pull and junction boxes and conduit at the termination points.

    d. Label outlets and switches in front with printed labels, back of plate use indelible ink.

2.03 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:

    1. Black letters on an orange field.

    2. Legend: Indicate voltage.

B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied.
2. Colors for 208/120-V Circuits:
    a. Phase A: Black.
    b. Phase B: Red.
    c. Phase C: Blue.
    d. Color for Neutral: White
        1. Colored stripe to indicate which phase it is connected to.
3. Colors for 480/277-V Circuits:
    a. Phase A: Brown.
    b. Phase B: Orange.
    c. Phase C: Yellow.
    d. Color for Neutral: White
        1. Colored stripe to indicate which phase it is connected to.
4. Color for Equipment Grounds: Green.
5. Colors for Isolated Grounds: Green with white stripe.
6. Colors for Low-Voltage Lighting Controls: Yellow.

C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

F. Equipment Identification Labels:

1. White letters on a black field.

a. Switchboards, panelboards, transformers, disconnects, and enclosed circuit breakers.

2.04 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil- (0.08-mm-) thick, vinyl flexible label with acrylic pressure-sensitive adhesive.

1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.

2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

2.05 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameters sized to suit diameters and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.06 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-adhesive vinyl tape is generally used to identify flexible conduits and phase conductors. See Part 3 for application instructions.

C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide; compounded for outdoor use.

D. Tape and Stencil: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers placed diagonally over orange background and are 12 inches (300 mm) wide. Stop stripes at legends.

E. Floor Marking Tape: 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

F. Underground-Line Warning Tape:

1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communication utility lines.

b. Printing on tape shall be permanent and shall not be damaged by burial operations.

c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:

a. Comply with ANSI Z535.1, ANSI Z535.2, ANSI Z535.3, ANSI Z535.4, and ANSI Z535.5.

b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".

c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

G. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch (25 mm).

2.07 SIGNS

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.

2. Thickness:

a. For signs up to 20 sq. in. (129 sq. cm), minimum 1/16 inch (1.6 mm) thick.

b. For signs larger than 20 sq. in. (129 sq. cm), 1/8 inch (3.2 mm) thick.

c. Punched or drilled for mechanical fasteners with 1/4-inch (6.4-mm) grommets in corners for mounting.

d. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.08 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black, except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

5. Color: Black.

2.09 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 EXECUTION

3.01 PREPARATION

A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.02 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings,

manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.

    1. Secure tight to surface of conductor, cable, or raceway.

H. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.

    1. Secure tight to surface of conductor, cable, or raceway.

I. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

J. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

K. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:

    1. "EMERGENCY POWER."

    2. "POWER."

L. Vinyl Wraparound Labels:

    1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

    2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

M. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

N. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.

O. Self-Adhesive Labels:

1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

P. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

Q. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

R. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

S. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

T. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

U. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

V. Underground Line Warning Tape:

1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

2. Install underground-line warning tape for direct-buried cables and cables in raceways.

W. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use labels 2 inches (50 mm) high.

X. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

3.03 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30A and 120V to Ground: Identify with self-adhesive vinyl tape applied in bands.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."

2. "POWER."

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide self-adhesive labels with the conductor designation.

H. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:

1. Floor surface directly above conduits running beneath and within 12 inches (300 mm) of a floor that is in contact with earth or is framed above unexcavated space.

2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.

K. Workspace Indication: Apply[floor marking tape to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

L. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

M. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive labels.

1. Apply to exterior of door, cover, or other access.

2. For equipment with multiple power or control sources, apply to door or cover of equipment, including, but not limited to, the following:

a. Power-transfer switches.

b. Controls with external control power connections.

N. Arc Flash Warning Labeling: Self-adhesive labels.

O. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

P. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer.

Q. Equipment Identification Labels:

1. Indoor Equipment: Laminated acrylic or melamine plastic sign.

2. Outdoor Equipment: Laminated acrylic or melamine sign.

3. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchboards.

e. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Emergency system boxes and enclosures.

g. Enclosed switches.

h. Enclosed circuit breakers.

i. Enclosed controllers.

j. Variable-speed controllers.

k. Push-button stations.

l. Power-transfer equipment.

m. Contactors.

n. Remote-controlled switches, dimmer modules, and control devices.

o. Battery-inverter units.

p. Battery racks.

q. Power-generating units.

r. Monitoring and control equipment.

s. UPS equipment.

END OF SECTION

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SECTION 26 05 72

OVERCURRENT PROTECTIVE DEVICE SHORT-CIRCUIT STUDY

PART 1 GENERAL

1.01SUMMARY

A. Section includes a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.02 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Other Action Submittals: Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.

1. Short-circuit study input data, including completed computer program input data sheets.

2. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.

a. Submit study report for action prior to receiving final approval of the distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that the selection of devices and associated characteristics is satisfactory.

b. Revised single-line diagram, reflecting field investigation results and results of short-circuit study.

1.03 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Short-Circuit Study Specialist.

1.04 QUALITY ASSURANCE

A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are unacceptable.

B. Short-Circuit Study Software Developer Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. The computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

C. Short-Circuit Study Specialist Qualifications: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

PART 2 PRODUCTS

2.01 COMPUTER SOFTWARE

A. SKM Power Tools

B. Comply with IEEE 399 and IEEE 551.

C. Analytical features of fault-current-study computer software program shall have the capability to calculate mandatory features as listed in IEEE 399.

2.02 SHORT-CIRCUIT STUDY REPORT CONTENTS

A. Executive summary.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of the computer printout.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Cable size and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, and panelboard designations.

D. Comments and recommendations for system improvements, where needed.

E. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short-circuit ratings.

2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.

3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.

F. Short-Circuit Study Input Data: As described in "Power System Data" Article in the Evaluations.

G. Short-Circuit Study Output:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. Equivalent impedance.

2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. Calculated asymmetrical fault currents:

1) Based on fault-point X/R ratio.

2) Based on calculated symmetrical value multiplied by 1.6.

3) Based on calculated symmetrical value multiplied by 2.7.

3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 EXECUTION

3.01 EXAMINATION

A. Obtain all data necessary for the conduct of the study.

1. Verify completeness of data supplied on the one-line diagram. Call any discrepancies to the attention of Architect.

2. For equipment provided that is Work of this Project, use characteristics submitted under the provisions of action submittals and information submittals for this Project.

B. Gather and tabulate the following input data to support the short-circuit study:

1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance at the service.

3. Power sources and ties.

4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.

5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.

6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.

7. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.

8. Motor horsepower and NEMA MG 1 code letter designation.

9. Cable sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

3.02 SHORT-CIRCUIT STUDY

A. Perform study following the general study procedures contained in IEEE 399.

B. Calculate short-circuit currents according to IEEE 551.

C. Base study on the device characteristics supplied by device manufacturer.

D. Begin short-circuit current analysis at the service, extending down to the system overcurrent protective devices as follows:

1. To normal system low-voltage load buses where fault current is 10 kA or less.

2. Exclude equipment rated 240-V ac or less when supplied by a single transformer rated less than 125 kVA.

E. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.

F. The calculations shall include the ac fault-current decay from induction motors. The calculations shall also account for the fault-current dc decrement, to address the asymmetrical requirements of the interrupting equipment.

1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.

G. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each of the following:

1. Electric utility's supply termination point.

2. Incoming switchgear.

3. Low-voltage switchgear.

4. Control panels.

5. Automatic transfer switches.

6. Branch circuit panelboards.

7. Disconnect switches.

3.03 ADJUSTING

A. Make minor modifications to equipment as required to accomplish compliance with short-circuit study.

3.04 DEMONSTRATION

A. Train Owner's operating and maintenance personnel in the use of study results.

END OF SECTION

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SECTION 26 09 23

LIGHTING CONTROL DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Indoor occupancy and vacancy sensors.

2. Switchbox-mounted occupancy sensors.

B. Related Requirements:

1. Section 260943 "Distributed Digital Lighting Control System" for centralized lighting controls.

2. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show installation details for the following:

a. Occupancy sensors.

b. Vacancy sensors.

2. Interconnection diagrams showing field-installed wiring.

3. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Suspended ceiling components.

2. Structural members to which equipment will be attached.

3. Items penetrating finished ceiling, including the following:
    a. Luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Control modules.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.06 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
    a. Faulty operation of lighting control devices.
2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Match same manufacturer as selected in Section 260943 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM.

2.02 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

1. Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
2. Dual technology.
3. Integrated power pack.
4. Hardwired connection to BAS.

5. Retain subparagraphs below to specify various types of units required for Project.

6. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

7. Operation:

    a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

    b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

8. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.

9. Coordinate "Power" and "Power Pack" paragraphs with sensor type.

10. Power: Line voltage.

11. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

12. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.

    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

13. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

14. Bypass Switch: Override the "on" function in case of sensor failure.

15. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

B. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

    1. Sensitivity Adjustment: Separate for each sensing technology.

    2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq.

cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.03 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

4. Switch Rating: Not less than 1200-VA LED load at 277 V, and 800-W incandescent.

B. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of [900 sq. ft. (84 sq. m)] [2100 sq. ft (196 sq. m)].

2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."

4. Capable of controlling load in three-way application.

5. Voltage: Match the circuit voltage.

6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

8. Concealed, "off" time-delay selector at 30 seconds and 5, 10, and 20 minutes.

9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

10. Color: Confirm with architect prior to ordering.

11. Faceplate: Color matched to switch.

2.04 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.03 CONTACTOR INSTALLATION

A. Comply with NECA 1.

B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.04 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.05 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.06 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Lighting control devices will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.07 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.

3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.08 SOFTWARE SERVICE AGREEMENT

A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] <Insert number> years from date

of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.09 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943 "Distributed Digital Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION

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SECTION 26 09 43

DISTRIBUTED DIGITAL LIGHTING CONTROLS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   a. Distributed Digital Lighting Control System: System includes:
   b. Digital Lighting Load Controls
B. Emergency Lighting Control.
C. Related Requirements:
   a. Section 260923 "Lighting Control Devices."
   b. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NEMA - National Electrical Manufacturers Association

C. FCC emission standards

D. UL - Underwriters Laboratories, Inc. Listings

E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.

F. UL 924 - Standard for Emergency Lighting and Power Equipment

1.04 PERFORMANCE REQUIREMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.05 ACTION SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   a. Catalog sheets and specifications.
   b. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
   c. Storage and handling requirements and recommendations.
   d. Installation instructions.

B. Shop Drawings: Wiring diagrams a for the various components of the System specified including:
   a. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.

b. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.

c. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.

d. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

1.06 INFORMATIONAL SUBMITTALS

A. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

B. Field quality-control reports.

C. Sample Warranty: For manufacturer's warranties.

1.07CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual installed locations and settings for lighting control devices.

B. Operation and Maintenance Manual:

a. Include approved Shop Drawings and Product Data.

b. Include Sequence of Operation, identifying operation for each room or space.

c. Include manufacturer's maintenance information.

d. Operation and Maintenance Data: Include detailed information on device programming and setup.

e. Include startup and test reports.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of networked lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.09 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Architect, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:

a. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.

b. Review the specifications for low voltage control wiring and termination.

c. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.

d. Discuss requirements for integration with other trades.

C. Inspect and make notes of job conditions prior to installation:

a. Record minutes of the conference and provide copies to all parties present.

b. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.

c. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Architect.

1.10 DELIVERY, STORAGE AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.11 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   a. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
   b. Relative humidity: Maximum 90 percent, non-condensing.

1.12 WARRANTY

A. Manufacturer shall provide a 5-year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   a. Acuity nLight
   b. Requests for substitutions will be considered in accordance with provisions of Division 01.

2.02 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. System General: Provide Digital Lighting Management System complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Architect for clarification prior to proceeding.
   a. Space Control Requirements: Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality as indicated in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, gymnasium, cafeteria/commons and learning classroom/lab. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
   b. Daylit Areas: Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by IECC 2015:
      i. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
      ii. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
      iii. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.
      iv. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.

a. Digital Lighting Management local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.
b. Digital Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.
c. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
d. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.
e. Digital Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.
f. Configuration Tools: Handheld remote for room configuration and relay panel programming provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.
g. Programming and Configuration Software: Optional PC-native application capable of accessing control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.
h. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

C. Local Network: local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.
   a. Features of the local network include:
      i. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
      ii. Simple replacement of any device in the local network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.
      iii. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.
      iv. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.
   b. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
   c. District Standard: Low-voltage lighting controls cabling shall be yellow.
   d. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

2.03 DIGITAL LOAD CONTROLLERS (ROOM CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones, automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features

a. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
b. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
c. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
d. Device Status LEDs to indicate:
    i. Data transmission
    ii. Device has power
    iii. Status for each load
    iv. Configuration status
e. Quick installation features including:
    i. Standard junction box mounting
    ii. Quick low voltage connections using standard RJ-45 patch cable
f. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    i. Turn on to 100 percent
    ii. Turn off
    iii. Turn on to last level
g. Each load be configurable to operate in the following sequences based on occupancy:
    i. Auto-on/Auto-off (Follow on and off)
    ii. Manual-on/Auto-off (Follow off only)
h. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
i. BACnet object information shall be available for the following objects:
    i. Load status
    ii. Schedule state, normal or after-hours
    iii. Demand Response enable and disable
    iv. Room occupancy status
    v. Total room lighting watts
    vi. Force on/off all loads
j. UL 2043 plenum rated
k. Manual override and LED indication for each load
l. Zero cross circuitry for each load
m. All digital parameter data programmed into an individual room controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
n. Dimming Room Controllers shall share the following features:
    i. Each load shall have an independently configurable preset on level for Normal Hours and After-Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
    ii. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    iii. The following dimming attributes may be changed or selected using a wireless configuration tool:
        1. Establish preset level for each load from 0-100 percent
        2. Set high and low trim for each load
        3. Initiate lamp burn in for each load of either 0, 12 or 100 hours
    iv. Override button for each load provides the following functions:
        1. Press and release for on/off control
        2. Press and hold for dimming control

o. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
p. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
q. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
r. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

B. On/Off/0-10V Dimming Enhanced Room Controllers shall include:
a. Dual voltage (120/277 VAC, 60 Hz) capable or 347 VAC, 60 Hz. 120/277 volt models rated for 20A total load; 347 volt models rated for 15A total load
b. Built in real time current monitoring
c. One, two or three relays configurations
d. Smart 250 mA switching power supply
e. Four RJ-45 local network ports. Provide integral strain relief
f. One dimming output per relay
i. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.

2.04 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
a. Digital calibration and pushbutton configuration for the following variables:
i. Sensitivity, 0-100 percent in 10 percent increments
ii. Time delay, 1-30 minutes in 1-minute increments
iii. Test mode, Five second time delay
iv. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
v. Walk-through mode
b. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the local network.
c. Programmable control functionality including:
i. Each sensor may be programmed to control specific loads within a local network.
ii. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
iii. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
iv. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
1. Ultrasonic and Passive Infrared
2. Ultrasonic or Passive Infrared
3. Ultrasonic only
4. Passive Infrared only
v. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.
d. One or two RJ-45 port(s) for connection to local network.

e. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
f. Device Status LEDs, which may be disabled for selected applications, including:
    i. PIR detection
    ii. Ultrasonic detection
    iii. Configuration mode
    iv. Load binding
g. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.
h. Manual override of controlled loads.
i. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:
    a. Detection state
    b. Occupancy sensor time delay
    c. Occupancy sensor sensitivity, PIR and Ultrasonic
C. Units shall not have any dip switches or potentiometers for field settings
D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology local network. No additional configuration will be required.

2.05 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:
    a. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
    b. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
B. Configuration LED on each switch that blinks to indicate data transmission.
C. Load/Scene Status LED on each switch button with the following characteristics:
    a. Bi-level LED
    b. Dim locator level indicates power to switch
    c. Bright status level indicates that load or scene is active
    d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.
D. Programmable control functionality including:
    a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority
    b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.
E. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.
F. BACnet object information shall be available for the following objects:
    a. Button state
    b. Switch lock control
    c. Switch lock status
G. Two RJ-45 ports for connection to local network.
H. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology local network. No additional configuration shall be required to achieve multi-way switching.
I. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.

a. Individual button function may be configured to Toggle, On only or Off only.
b. Individual scenes may be locked to prevent unauthorized change.
c. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
d. Ramp rate may be adjusted for each dimmer switch.
e. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
f. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.06 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.
   a. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
   b. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
   c. Dual loop sensors measure both ambient and incoming daylight in the space to ensure that proper light levels are maintained as changes to reflective materials are made in a single zone

B. Digital daylighting sensors shall include the following features:
   a. Sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
   b. Sensor light level range shall be from 1-6,553 foot-candles (fc).
   c. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).
   d. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
   e. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
   f. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
   g. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
   h. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
   i. Configuration LED status light on device that blinks to indicate data transmission.
   j. Status LED indicates test mode, override mode and load binding.
   k. Recessed switch on device to turn controlled load(s) ON and OFF.
   l. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
      i. Light level
      ii. Day and night setpoints
      iii. Off time delay
      iv. On and off setpoints

v. Up to three zone setpoints
vi. Operating mode - on/off, bi-level, tri-level or dimming

m. One RJ-45 port for connection to local network.
n. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick. Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick. Mounting brackets are compatible with J boxes and wall mounting. Photosensor to be mounted on included bracket below skylight well.
o. Any load or group of loads in the room can be assigned to a daylighting zone
p. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
q. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Closed loop digital photosensors shall include the following additional features:
a. An internal photodiode that measures light in a 100-degree angle, cutting off the unwanted light from bright sources outside of this cone.
b. Automatic self-calibration, initiated from the photosensor, a wireless configuration tool or a PC with appropriate software.
c. Automatically establishes application-specific setpoints following self-calibration. For switching operation, an adequate deadband between the ON and OFF setpoints shall prevent the lights from cycling; for dimming operation a sliding setpoint control algorithm with separate Day and Night setpoints shall prevent abrupt ramping of loads.

2.07 POWER BOOSTERS

A. Power booster includes a high-efficiency switching power supply to add power to a Digital Lighting Management local network.
a. Intended for use controllers to enable integration of occupancy sensors, daylighting sensors and switches for energy-efficient lighting control.
b. Does not include a relay for load control.

B. Operation:
a. Operates on 120/230/277VAC
b. Provides 150mA of Class 2 power to fixture controllers, sensors and switches via the local network.
c. Once all devices are powered up, Plug n' Go automatically configures system components for the most energy-efficient operation. Controllers then switch or dim loads in response to input from the communicating devices.
d. The system may be reconfigured using Push n' Learn without the need for tools or a PC.
e. One or two power boosters may also be installed in a zone controller to provide extra power for either or both local networks.

C. Specifications:
a. 3 RJ45 ports with integral strain relief and hinged dust cover
b. Attaches to a zone controller or standard electrical box through ½" knockout; UL2043 plenum rated.
c. Class 2 output to local network: 24VDC, 150mA across 3 RJ45 ports
d. Local network parameters with Room Controllers:
i. Maximum of 4 total -100 series devices listed above
ii. Maximum current: 600mA
iii. Cat 5e cable: 150' per device to 1,000' max.
iv. Up to 24 communicating devices

2.08 HANDHELD CONFIGURATION TOOLS

A. Provide a wireless configuration tool to facilitate customization of local networks using two-way infrared communications, and/or PC software that connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:
   a. Two-way infrared (IR) communication with IR-enabled devices within a range of approximately 30 feet.
   b. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
   c. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify devices by type and serial number.
   d. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
   e. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
   f. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
   g. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
   h. Verify status of building level network devices.

2.09 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

B. Additional parameters exposed through this method include but are not limited to:
   a. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
   b. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after-hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
   c. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
   d. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
   e. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
   f. Load control polarity reversal so that on events turn loads off and vice versa.
   g. Per-load DR (demand response) shed level in units of percent.
   h. Load output pulse mode in increments of 1second.
   i. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:
   a. Device list report: All devices in a project listed by type.
   b. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.

c. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
d. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
e. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
f. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
g. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:
a. Set, copy/paste an entire project site of sensor time delays.
b. Set, copy/paste an entire project site of sensor sensitivity settings.
c. Search based on room name and text labels.
d. Filter by product type to allow parameter set by product.
e. Filter by parameter value to search for product with specific configurations.

E. Network-wide firmware upgrading remotely via the BACnet/IP network.
a. Mass firmware update of entire rooms.
b. Mass firmware update of specifically selected rooms or areas.
c. Mass firmware upgrade of specific products

2.10 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:
a. 120/277 volts, 50/60 Hz, 20 amp ballast rating
b. Push to test button
c. Auxiliary contact for remote test or fire alarm system interface

PART 3 EXECUTION

3.01 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.
B. If preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.02 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.
B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.
a. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
b. Install all room to room network devices using manufacturer-supplied MSTP network wire. Network wire substitution is not permitted and may result in loss of product warranty.
c. Low voltage wiring topology must comply with manufacturer's specifications.

d. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.
D. Test all devices to ensure proper communication.
E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.
F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:
    a. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
    b. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
    c. Load Parameters (e.g. blink warning, etc.)
G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Owner's requirements 30 days from beneficial occupancy. Provide a detailed report to the Architect / Owner of post start-up activity.
H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.
I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.
J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.
K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Architect and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.
B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.
    a. Verify Class I and II wiring connections are terminated properly by validating system performance.
    b. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
    c. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
    d. Verify that the control of each space complies with the Sequence of Operation.
    e. Correct any system issues and retest.
C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:
    a. Date of test or inspection.
    b. Loads per space, or Fixture Address identification.
    c. Quantity and Type of each device installed
    d. Reports providing each device's settings.

3.04 COMMISSIONING ASSISTANCE

A. Acceptance Testing Service; Include additional costs for Lighting Control Manufacturer to provide a technician for one additional day while the Commissioning Agent performs lighting control acceptance testing in accordance with IECC 2015 including submission of required documentation.

3.05 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day Owner instruction period to designated Owner personnel. Set-up, starting of the lighting control system and Owner instruction includes:

a. Confirmation of entire system operation and communication to each device.
b. Confirmation of operation of individual relays, switches, and sensors.
c. Confirmation of system Programming, photocell settings, override settings, etc.
d. Provide training to cover installation, programming, operation, and troubleshooting of the lighting control system.

3.06 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Owner following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

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SECTION 26 24 16

PANELBOARDS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

   a. Distribution panelboards.

   b. Lighting and appliance branch-circuit panelboards.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 DEFINITIONS

A. ATS: Acceptance testing specification.

B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. HID: High-intensity discharge.

E. MCCB: Molded-case circuit breaker.

F. SPD: Surge protective device.

G. VPR: Voltage protection rating.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

   a. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.

   b. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

   a. Include dimensioned plans, elevations, sections, and details.

b. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.

c. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.

d. Detail bus configuration, current, and voltage ratings.

e. Short-circuit current rating of panelboards and overcurrent protective devices.

f. Include evidence of NRTL listing for series rating of installed devices.

g. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

h. Include wiring diagrams for power, signal, and control wiring.

i. Key interlock scheme drawing and sequence of operations.

j. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

b. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.07MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

a. Keys: Two spares for each type of panelboard cabinet lock.

b. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.

c. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

d. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.08 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.

B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

A. Environmental Limitations:

   a. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

   b. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

      i. Ambient Temperature: Not exceeding minus 22 deg F (minus 30 deg C) to plus 104 deg F (plus 40 deg C).

      ii. Altitude: Not exceeding 6600 feet (2000 m).

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

   a. Ambient temperatures within limits specified.

   b. Altitude not exceeding 6600 feet (2000 m).

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

   a. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Comply with NEMA PB 1.

E. Comply with NFPA 70.

F. Enclosures: Flush and Surface-mounted, dead-front cabinets.

   a. Rated for environmental conditions at installed location.

   b. Indoor Dry and Clean Locations: NEMA 250, Type 1.

   c. Outdoor Locations: NEMA 250, Type 3R.

   d. Kitchen Areas: NEMA 250, Type 4X, stainless steel.

G. Height: 84 inches (2.13 m) maximum.

H. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.

I. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

J. Finishes:

   a. Panels and Trim: Steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.

   b. Back Boxes: Same finish as panels and trim.

K. Incoming Mains:

   a. Location: [Top] [Bottom] [Convertible between top and bottom].

   b. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

L. Phase, Neutral, and Ground Buses:

   a. Material: Copper only.

      i. Plating shall run entire length of bus.

      ii. Bus shall be fully rated the entire length.

   b. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.

c. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.

d. Full-Sized Neutral: Equipped with full-capacity bonding strap for service entrance applications. Mount electrically isolated from enclosure. Do not mount neutral bus in gutter.

M. Conductor Connectors: Suitable for use with conductor material and sizes.

a. Material: Copper only.

b. Terminations shall allow use of 75 deg C rated conductors without derating.

c. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

d. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.

e. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.

f. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

g. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

N. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.

O. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

a. Percentage of Future Space Capacity: 25 percent.

P. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.

a. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.

b. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.

2.02 PERFORMANCE REQUIREMENTS

A. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 2.

2.03 DISTRIBUTION POWER PANELBOARDS

A. Panelboards: NEMA PB 1, distribution type.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

   a. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.

C. Mains: See Plans.

D. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.04 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

B. Mains: See Plans.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.05 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

   a. Thermal-Magnetic Circuit Breakers:

      i. Inverse time-current element for low-level overloads.

      ii. Instantaneous magnetic trip element for short circuits.

      iii. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

   b. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

   c. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

   d. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).

   e. Subfeed Circuit Breakers: Vertically mounted.

   f. MCCB Features and Accessories:

i. Standard frame sizes, trip ratings, and number of poles.

ii. Breaker handle indicates tripped status.

iii. UL listed for reverse connection without restrictive line or load ratings.

iv. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.

v. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.

vi. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.

vii. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.

viii. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

ix. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.

x. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.

xi. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.

xii. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.

a. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."

b. Fused Switch Features and Accessories:

i. Standard ampere ratings and number of poles.

ii. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.

2.06 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

a. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.07 ACCESSORY COMPONENT AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in NFPA 70.

B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.

C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.

D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Comply with NECA 1.

C. Install panelboards and accessories according to NEMA PB 1.1.

D. Equipment Mounting:

a. Attach panelboard to the vertical finished or structural surface behind the panelboard.

E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.

F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches (2286 mm) above finished floor unless otherwise indicated.

H. Mount panelboard cabinet plumb and rigid without distortion of box.

I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

J. Mount surface-mounted panelboards to steel slotted supports 5/8 inch (16 mm) in depth. Orient steel slotted supports vertically.

K. Install overcurrent protective devices and controllers not already factory installed.

   a. Set field-adjustable, circuit-breaker trip ranges.

   b. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

M. Install filler plates in unused spaces.

N. Stub four 1-inch (25 mm) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (25 mm) empty conduits into raised floor space or below slab not on grade.

O. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

P. Mount spare fuse cabinet in accessible location.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Acceptance Testing Preparation:

   a. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.

   b. Test continuity of each circuit.

C. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.

   a. Measure loads during period of normal facility operations.

   b. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.

   c. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.

   d. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.06 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION

SECTION 26 27 26

WIRING DEVICES

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:

1. Standard-grade receptacles, 125 V, 20 A.
2. GFCI receptacles, 125 V, 20 A.
3. Twist-locking receptacles.
4. Pendant cord-connector devices.
5. Cord and plug sets.
6. Toggle switches, 120/277 V, 20 A.
7. Wall plates.

B. Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.03 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. GFCI: Ground-fault circuit interrupter.

D. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.05 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 PRODUCTS

2.01 GENERAL WIRING-DEVICE REQUIREMENTS

A. District Standards - Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1:

B. Approved Manufacturers.

1. Arrow Hart
2. Bryant
3. Eagle
4. Hubbell
5. Leviton
6. Lutron
7. Pass & Seymour

C. Floor mounted service fittings:

1. Legrand/Wiremold

D. Cord Drops:

1. Daniel Woodhead with strain relief at both ends, or approved equivalent.

E. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

F. Comply with NFPA 70.

G. RoHS compliant.

H. Comply with NEMA WD 1.

I. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

J. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

K. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Essential Electrical System: Red.

L. Wall Plate Color: For plastic covers, match device color.

M. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.02 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A, “TR”:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 and FS W-C-596.

4. "Marking" Subparagraph below requires compliance with NFPA 70, Article 406.12.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A, “WP”:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498.

4. "Marking" Subparagraph below requires compliance with NFPA 70, Articles 406.9 and 406.12.

5. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.03 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A, “GFI”:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A, “TR/GFI”:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A, “WP/GFI”:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498 and UL 943 Class A.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.04 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Receptacles, 120 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L5-20R.

2. Standards: Comply with UL 498.

B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Configuration: NEMA WD 6, Configuration L6-20R.

2. Standards: Comply with UL 498.

2.05 PENDANT CORD-CONNECTOR DEVICES

C. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.

D. Configuration: Match receptacle configuration at outlet provided for equipment.

E. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.

F. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

G. Cord Size:

1. Suitable for connected load of equipment and rating of branch circuit overcurrent protection.

2. Not less than 12 AWG.

H. Standards: Comply with FS W-C-596.

2.06 CORD AND PLUG SETS

A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.07 TOGGLE SWITCHES, 120/277 V, 20 A

A. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

B. Two-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

C. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

D. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:

1. Description: Factory-supplied key in lieu of switch handle.

2. Standards: Comply with UL 20 and FS W-S-896.

2.08 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

PART 3 EXECUTION

3.01INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall comply with NFPA 70, Article 300, without pigtails.

D. Existing Conductors:

1. Cut back and pigtail, or replace all damaged conductors.

2. Straighten conductors that remain and remove corrosion and foreign matter.

3. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

E. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.02 GFCI RECEPTACLES

A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.03 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

C. Essential Electrical System: Mark receptacles supplied from the essential electrical system to allow easy identification using a self-adhesive label.

END OF SECTION

SECTION 26 28 13
FUSES

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

Section Includes:

Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Switchboards.
c. Enclosed controllers.
d. Enclosed switches.

Important Note: All sections indicated with “District Standards” shall supersede other similar specifications listed in this document.

1.2 ACTION SUBMITTALS

Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
Current-limitation curves for fuses with current-limiting characteristics.
Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software and in PDF format.
Coordination charts and tables and related data.
Fuse sizes for elevator feeders and elevator disconnect switches.

1.3 CLOSEOUT SUBMITTALS

Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017700 "Closeout Procedures," Section 017823 "Operation and Maintenance Data," include the following:

Ambient temperature adjustment information.
Current-limitation curves for fuses with current-limiting characteristics.
Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software and in PDF format.
Coordination charts and tables and related data.

1.4 MAINTENANCE MATERIAL SUBMITTALS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two sets of three of each size and type.

1.5 FIELD CONDITIONS

Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.0 MANUFACTURERS

District Standards - Work in this section is restricted to specific manufacturers that have been previously approved by Jefferson County School District, R-1.

Little Fuse Company
Bussman Corporation

Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.1 CARTRIDGE FUSES

Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

Type RK-1: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
Type RK-5: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
Type J: 600-V, zero- to 600-A rating, 200 kAIC, time delay.
Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

Comply with NEMA FU 1 for cartridge fuses.

Comply with NFPA 70.

Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 3 - EXECUTION

3.0 EXAMINATION

Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

Proceed with installation only after unsatisfactory conditions have been corrected.

3.1 FUSE APPLICATIONS

Cartridge Fuses:

Service Entrance: Class L, fast acting.
Feeders: Class L, time delay.
Motor Branch Circuits: Class RK5, time delay.
Large Motor Branch Circuits (601-4000 A): Class L, time delay.
Control Transformer Circuits: Class CC, time delay, control transformer duty.
Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.2 INSTALLATION

Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

3.3 IDENTIFICATION

Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16
ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.0 RELATED DOCUMENTS

Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.1 SUMMARY

Section Includes:

- Fusible switches.
- Nonfusible switches.
- Molded-case circuit breakers (MCCBs).
- Enclosures.

1.2 DEFINITIONS

NC: Normally closed.

NO: Normally open.

SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

- Enclosure types and details for types other than NEMA 250, Type 1.
- Current and voltage ratings.
- Short-circuit current ratings (interrupting and withstand, as appropriate).
- Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
- Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
- Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF format.

Shop Drawings: For enclosed switches and circuit breakers.

Include plans, elevations, sections, details, and attachments to other work.
Include wiring diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF format.

1.6 MAINTENANCE MATERIAL SUBMITTALS

Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
Fuse Pullers: Two for each size and type.

1.7 FIELD CONDITIONS

Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
Altitude: Not exceeding 6600 feet (2010 m).

1.8 WARRANTY

Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.0 GENERAL REQUIREMENTS

Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

Comply with NFPA 70.

2.1 FUSIBLE SWITCHES

Type HD, Heavy Duty:

Single throw.
Three pole.
600-V ac.
1200 A and smaller.
UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

Accessories:

Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
Lugs: Mechanical type, suitable for number, size, and conductor material.
Service-Rated Switches: Labeled for use as service equipment.

2.2 NONFUSIBLE SWITCHES

Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

Accessories:

Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
Lugs: Mechanical type, suitable for number, size, and conductor material.

2.3 MOLDED-CASE CIRCUIT BREAKERS

Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 80 percent rated.

MCCBs shall be equipped with a device for locking in the isolated position.

Lugs shall be suitable for 140 deg F (60 deg C) rated wire on 125-A circuit breakers and below.

Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

Instantaneous trip.
Long- and short-time pickup levels.

Long- and short-time time adjustments.
Ground-fault pickup level, time delay, and I-squared t response.

Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

Features and Accessories:

Standard frame sizes, trip ratings, and number of poles.
Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.4 ENCLOSURES

Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1); gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is

released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

PART 3 - EXECUTION

3.0 EXAMINATION

Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

Proceed with installation only after unsatisfactory conditions have been corrected.

Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.1 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.

Indoor, Dry and Clean Locations: NEMA 250, Type 1.
Outdoor Locations: NEMA 250, Type 3R.
Kitchen Areas: NEMA 250, Type 4X, stainless steel.

3.2 INSTALLATION

Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

Install fuses in fusible devices.

Comply with NFPA 70 and NECA 1.

3.3 IDENTIFICATION

Comply with requirements in Section 260553 "Identification for Electrical Systems."

Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 ADJUSTING

Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION

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SECTION 26 51 19

LED INTERIOR LIGHTING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes LED luminaires for interior applications.

B. Related Requirements:

1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including occupancy and vacancy sensors.

2. Section 260943 "Distributed Digital Lighting Controls" for programmable room/area control systems.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.

2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaires.

4. Include emergency lighting units, including batteries and chargers.

5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.

6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project. Indicate conformance with IES LM-79 and IES LM-80.

    a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.

2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

D. Product Certificates: For each time of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

B. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.06 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

2. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.07 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.09 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 5 to 104 deg F (Minus 15 to plus 40 deg C)

1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 5335 feet (300 m).

2.02 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:

a. "USE ONLY" and include specific lamp type.

b. Lamp diameter, shape, size, wattage, and coating.

c. CCT and CRI.

C. Recessed luminaires shall comply with NEMA LE 4.

2.03 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.

2. Sheet metal components shall be steel unless otherwise indicated.

3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.

2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. Manufacturer's standard grade.

2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.04 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.05 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.01EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports:

1. Sized and rated for luminaire weight.

2. Able to maintain luminaire position after cleaning and relamping.

3. Provide support for luminaire without causing deflection of ceiling or wall.

4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaires:

1. Secured to outlet box.

2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.

3. Trim ring flush with finished surface.

F. Wall-Mounted Luminaires:

1. Attached to structural members in walls

2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaires:

1. Ceiling/Structure Mount:

a. Pendant mount with 5/32-inch- (4-mm-) diameter aircraft cable supports adjustable to 10 feet (3 m) in length.

2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.

3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.

4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.

5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.

2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.

3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.03 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

3.05 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943 "Distributed Digital Lighting Controls."

3.06 ADJUSTING

A. Verify with Owner that adjusting service is required for Project.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.

2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

SECTION 26 56 19
LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

B. Section Includes:
1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.

C. Related Requirements:
1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including occupancy and vacancy sensors.
2. Section 260943 "Distributed Digital Lighting Controls" for programmable room/area control systems.

1.03 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color rendering index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. Lumen: Measured output of lamp and luminaire, or both.

F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of luminaire.
1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaire.
4. Lamps - include life, output (lumens, CCT, and CRI), and energy-efficiency data.
5. Photometric data and adjustment factors based on laboratory tests, complying with IES Lighting Measurements Testing and Calculation Guides, of each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project. Include IES LM-79 and IES LM-80 rating conformance.
   a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
6. Wiring diagrams for power, control, and signal wiring.
7. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.

D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

E. Delegated-Design Submittal: For luminaire supports.
   1. Include design calculations for luminaire supports.

1.05 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Luminaires.
   2. Structural members to which equipment and luminaires will be attached.
   3. Underground utilities and structures.
   4. Existing underground utilities and structures.
   5. Above-grade utilities and structures.
   6. Existing above-grade utilities and structures.
   7. Building features.
   8. Vertical and horizontal information.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Product Certificates: For each type of the following:
   1. Luminaire.

D. Source quality-control reports.

E. Sample warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1.07 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.08 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Provide luminaires from a single manufacturer for each luminaire type.

C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

D. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.

B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures, including luminaire support components.
      b. Faulty operation of luminaires and accessories.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   2. Verify available warranties and warranty periods.
      a. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 LUMINAIRE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

D. UL Compliance: Comply with UL 1598 and listed for wet location.

E. CRI of minimum 70. CCT of 4000 K.

F. L70 lamp life of 50,000 hours.

G. Internal driver.

H. Nominal Operating Voltage: 277 V ac.

I. In-line Fusing: On the primary for each luminaire.

J. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.

K. Source Limitations: Obtain luminaires from single source from a single manufacturer.

L. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.02 MATERIALS

A. Metal Parts: Free of burrs and sharp corners and edges.

B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.

C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.

D. Diffusers and Globes:
   1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
   2. Glass: Annealed crystal glass unless otherwise indicated.

3. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

A. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

B. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
   1. White Surfaces: 85 percent.
   2. Specular Surfaces: 83 percent.
   3. Diffusing Specular Surfaces: 75 percent.

C. Housings:
   1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
   2. Provide filter/breather for enclosed luminaires.

D. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
   1. Label shall include the following lamp characteristics:
      a. "USE ONLY" and include specific lamp type.
      b. Lamp diameter, shape, size, wattage and coating.
      c. CCT and CRI for all luminaires.

2.03 FINISHES

E. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

F. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.

G. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
   2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
   3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
   4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.
      a. Color: As indicated on Drawings.

H. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
   2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
      a. Color: As selected from manufacturer's standard catalog of colors.
      b. Color: Match Architect's sample of manufacturer's standard color.
      c. Color: As selected by Architect from manufacturer's full range.

2.04 LUMINAIRE SUPPORT COMPONENTS

I. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.

C. Examine walls, roofs, and exterior columns for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.03 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Retain first paragraph below if seismic restraint is required by local code or authorities having jurisdiction. See the Evaluations.

C. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

D. Install lamps in each luminaire.

E. Fasten luminaire to structural supports.

F. Supports:
   1. Sized and rated for luminaire weight.
   2. Able to maintain luminaire position after cleaning and re-lamping.
   3. Support luminaires without causing deflection of finished surface.
   4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.

J. Wall-Mounted Luminaire Support:
   1. Attached to structural members in walls

K. Wiring Method: Install cables in raceways. Conceal raceways and cables.

L. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.

M. Coordinate layout and installation of luminaires with other construction.

N. Adjust luminaires that require field adjustment or aiming.

O. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.04 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch- (0.254-mm-) thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.05 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.06 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Verify operation of photoelectric controls.

C. Illumination Tests:
   1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
      a. IES LM-5.
      b. IES LM-50.
      c. IES LM-52.
      d. IES LM-64.
      e. IES LM-72.
   2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

D. Luminaire will be considered defective if it does not pass tests and inspections.

E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain luminaires.

3.08 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
   1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
   2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
   3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION

27 00 10 Communication Services – August 2021

- The purpose of this document is to provide guidelines, standards, and specifications for the installation of the various components of the communications cable plant for Jefferson County Colorado Public Schools District (hereinafter referred to as the District). Unless otherwise specified in writing, the contractor shall provide a warranty guaranteeing that all materials, installation, and workmanship meet specifications and are free from defects for a period of one year from the date of final acceptance. Labor and material needed to correct errors, replace parts, or perform repair shall be done at the contractor's expense.
- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by the District; see Section 27 05 10 for the List of Acceptable Materials. Work in District buildings is to be done only by vendors that are pre-approved by the District.
- Coordination:
    1. Contract Documents must clearly define and specify responsibilities to furnish rough-in, cable installation, and connections. Tasks shall be performed as follows:
        a. Outlet boxes shall be installed by the Electrical Contractor
        b. Underground conduits leading into the MDF room shall be installed by the Electrical Contractor
        c. Empty raceway shall be installed by Electrical Contractor
        d. Punch down blocks shall be installed by the Data Cable Installation Contractor
        e. Equipment racks shall be installed by the Cabling Contractor
        f. Horizontal and riser data cable shall be installed by the Cabling Contractor
        g. RJ45 jacks shall be installed by the Cabling Contractor
        h. Fully loaded patch panels shall be installed by the Cabling Contractor
        i. RJ34 connectors shall be installed by the Cabling Contractor

- Project Management:
    1. The District shall designate one Project Manager for each site-specific project; this District Project Manager shall be the single point of contact for the Contractor. In general, the Project Manager (PM) for larger projects shall work for the Facilities and Construction Management Department, and the Project Manager for smaller projects shall be an employee of the Information Technology Department (ITPM).
    2. The contractor shall provide weekly written reports via email to the PM detailing progress.
    3. Requests for access to limited access or restricted areas shall be made the work day prior to the required access.
    4. Information critical to the completion of the task or project shall be communicated to the PM, as the requirement becomes known.
    5. Casual information shall be passed during the scheduled progress report.
    6. The vendor shall maintain the District facility in a neat and orderly manner during the installation of the cabling system.
    7. The District shall designate staging and storage areas for the contractor's materials.
    8. At the completion of work in each area, the vendor shall perform a final cleaning to remove any dust, debris, and trash prior to moving the installation crew to the next work area.
- Standards:
    1. In the absence of other information, standards of the following organizations apply:
        a. ANSI/TIA/EIA 568 C 1-2, Category 6
        b. ANSI/TIA/EIA-569 C Commercial Building Telecommunications Infrastructure Cabling Standard
        c. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
        d. ANSI/EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications
        e. Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM)

f. American with Disabilities Act (ADA) for non-construction/maintenance/service personnel using the system and components

g. Federal Section 504 for students with disabilities and those non-construction/non-maintenance/non-service personnel using the system and components as relevant for federally funded projects. Confirm with the District Project Manager

- General:

1. Twisted pair
2. Cables shall be installed with no splices.
3. Fiber Optic cable may be spliced in accordance with manufacturer's specifications and best-practices guidelines ONLY with written permission of the ITPM.
4. The cable minimum bend radius and maximum tension specifications shall never be exceeded. If, at any time and even for a moment, either of these specifications is exceeded, the installer shall replace the cable prior to final acceptance at no additional cost to the District.
5. Each and every cable shall be carefully and legibly labeled at both ends via tape labels or an indelible ink marking pen.
6. Horizontal cable runs shall be supported at intervals of five (5) feet or less.
7. At no point shall cables rest on acoustic ceiling grids or panels or any other systems such as structure, lighting, fire alarm, fire sprinkler systems, plumbing, roofing or heating ducts.
8. The communications cable plant shall be run in its own support system.
9. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware.
10. The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
11. Any bundle that has more than 5 cables in it shall be supported by a cable saddle or Arlington Loop.
12. Bundles with 5 or fewer cables may use bridle rings, J-hooks, or Arlington Loops.
13. Coordinate types and fire-ratings of penetrations with fire-rated assemblies identified on drawings and other divisions.

- Tracer Wire:

    1. Reference Division 33 for type and size of tracer wire for underground utilities.
    2. Install warning caution tape above underground utility lines.
    3. Install at all underground utility and other lines, to run with each utility listed in this Division 27, including all underground conduits.
    4. Standard Colors:
        a. Orange: Fiber Optic or telecommunications

END OF SECTION 270010

27 05 00 Responsibility Matrix – August 2019

- Following is a matrix showing the various tasks and activities along with the party responsible for each task:

Paging System

TASK	IT Project Manager	District Project Manager	Commissioning Specialist	Facility Maintenance	Architect & Engineer	General Contractor
Validate Existing System				Optional		Required
Develop Specifications		Required	Required	Required	Required	
Plan Review		Required	Required	Required		
Product Submittal Review			Optional		Required	Required
Pre-Installation Meeting		Required	Required	Required	Required	Required
Day One Install			Required	Optional		Required
Periodic Inspection		Required	Required	Required	Required	

Rough-In		Required	Required	Required	Required	Required

Contractor End-to-End Test			Optional	Required	Required	Required
Final Inspection				Optional	Required	Required
System Certification		Required		Optional		
Agency Inspections						Required

Fire Alarm System

TASK	IT Project Manager	District Project Manager	Commissioning Specialist	Facility Maintenance	Architect & Engineer	General Contractor
Validate Existing System				Optional		Required
Develop Specifications		Required	Required	Required	Required	
Plan Review		Required	Required	Required		
Product Submittal Review			Optional		Required	Required
Pre-Installation Meeting						
Day One Install			Required	Optional		Required
Periodic Inspection		Required	Required	Required	Required	

Rough-In		Required	Required	Required	Required	Required
Annunciator Final Drawings		Optional			Required	Required
Contractor End-to-End Test			Optional	Required	Required	Required
Final Inspection				Optional	Required	Required
System Certification		Required		Optional		
Fire Department Checkout		Optional	Optional	Optional	Required	Required
Agency Inspections						Required

Telecommunications – Data Systems

TASK	IT Project Manager	District Project Manager	Commissioning Specialist	Facility Maintenance	Architect & Engineer	General Contractor
Validate Existing System	Required			Optional		Required
Develop Specifications		Required	Required	Required	Required	
Plan Review	Required	Required	Required	Required		
Product Submittal Review	Required		Optional		Required	Required

Pre-Installation Meeting	Required	Required	Required	Required	Required	Required

Day One Install			Required	Optional		Required
Periodic Inspection	Required	Required	Required	Required	Required	
Rough-In	Required	Required	Required	Required	Required	Required
Annunciator Final Drawings		Optional			Required	Required
Contractor End-to-End Test	Required		Optional	Required	Required	Required
Final Inspection	Required			Optional	Required	Required
System Certification	Optional	Required		Optional		
Fire Department Checkout		Optional	Optional	Optional	Required	Required
Agency Inspections						Required

END SECTION 27 05 00

27 05 10 List of Acceptable Materials – August 2019

- Items on this list are considered acceptable for use in District buildings wherever they meet all codes, standards, guidelines, and specifications for District Communication projects. Exceptions to these specific materials can only be made in writing by the IT Project Manager. Absent written authorization, the contractor shall use only district approved products. District Project Manager will provide the approved list of products and parts.

END SECTION 27 05 10

27 05 26 Grounding and Bonding for Communications Systems – August 2021

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
- See District's Technical Details Drawings.
- General Grounding and Bonding:
    1. All District facilities shall be equipped with a bonding backbone (TBB).
    2. The Electrical contractor shall supply and install all grounding to the Main Distribution Frame (MDF) and all Intermediate Distribution Frame (IDF) communications closets.
    3. This backbone shall be used to ground all cable shields, equipment, racks, cabinets, raceways, and other associated hardware.
    4. The TBB shall be installed independent of the building's electrical and building ground and shall be designed in accordance with the recommendations contained in the ANSI/TIA/EIA-607 TMGB.
    5. The Main Distribution Frame room in each building shall be equipped with a grounding bus bar (TGB).
    6. Each Intermediate Distribution Frame communications closet shall be provided with a TGB.
    7. The TGB shall be connected to the building electrical entrance grounding facility.
    8. The TGB and TBB are to provide a grounding system that is equal in potential to the building electrical ground system.
    9. All racks, metallic backboards, cable sheaths, metallic strength members, splice cases, cable trays, etc. entering or residing in any Communication Room shall be grounded to the respective TGB or TBB using a minimum #6 AWG stranded copper bonding conductor and compression connectors.
    10. Where metallic panels attached to the rack do not have sufficient metal-to-metal contact to provide an adequate path to ground, they shall be bonded to the rack using a minimum #14 AWG copper conductor.
    11. The copper conductor size shall be upgraded based on the largest power conductor feeding any rack mount equipment.
    12. The conductor shall be continuous. Components shall be grounded in a daisy chain fashion from top to bottom and bonded to the rack using an appropriate compression connector.

13. Insulated wires used for grounding purposes shall have green insulation.
14. Bare copper wires shall be identified at each termination point with a wrap of green electrical tape.
15. The TBB shall be designed and approved by a licensed engineer.
16. The TBB shall be installed in accordance with best industry practices.
17. A licensed electrician shall perform installation and termination of the main bonding conductor to the building service entrance ground.

END SECTION 27 05 26

27 05 28 Pathways for Communications Systems (Data and Voice) – August 2015

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1 Telecommunications Department.
- Coordination
    1. Empty raceway for special systems may or may not be under separate contract.
    2. See Data, Communications and Alarm Diagram.
    3. Contract Documents must clearly define and specify responsibilities to Furnish Rough-In / Install / and Connect:
        a. Outlet boxes – by Electrical Contractor
        b. Punch down blocks – by Cabling Contractor
        c. Equipment racks – by Cabling Contractor
        d. Empty raceway – by Electrical Contractor
        e. Cable – by Cabling Contractor
        f. RJ11 connectors – by Cabling Contractor
        g. RJ45 connectors – by Cabling Contractor
        h. F connectors for video connection – by Cabling Contractor
- In the absence of other information, standards of the following organizations apply:
    1. ANSI/TIA/EIA 568A-6, Category 6
    2. ANSI/TIA/EIA-568A Commercial Building Telecommunications Cabling Standard
    3. ANSI/EIA/TIA-569 Commercial Building Standard for Telecommunications Pathways and Spaces
    4. ANSI/EIA/TIA-606 Administration Standard for the Telecommunications Infrastructure of Commercial Buildings
    5. ANSI/EIA/TIA-607 Commercial Building Grounding and Bonding Requirements for Telecommunications

6. Building Industries Consulting Services International (BICSI) Telecommunications Distribution Methods Manual (TDMM)

- Cabling

1. Cables shall be installed in continuous lengths from origin to destination (no splices) unless specifically addressed in this guideline.
2. The cable's minimum bend radius and maximum pulling tension shall not be exceeded.
3. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the vendor prior to final acceptance at no cost to the District.
4. All cable shall be labeled at both ends via tape labels and/or a indelible ink marking pen and in a manner agreed upon by the District and the installer.
5. Support horizontal cables at a maximum of five-foot intervals.
6. At no point shall cable(s) rest on acoustic ceiling grids or panels or any other support systems such as structural members, lighting, fire alarm, plumbing, or heating ducts.
7. Cable plant will be run in its own support system.
8. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware.
9. The cabling system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
10. Any bundle that has more than 5 cables in it will be supported by a cable saddle or Arlington Loop.

    a. Bundles with 5 or less cables may use either bridle rings, J-hooks, or Arlington Loop.

- Submittals

1. Cable and supports:

    a. Product data

END SECTION 27 05 28

27 05 43 Underground Ducts and Raceways for Communications Systems – August 2015

- Work in this section is open to any product or material meeting the requirements of this section and the requirements of Division 26 Electrical as well as any requirements of the service providers that shall be using the conduits such as Century Link or Comcast.
- Requirements of Division 26 Electrical apply
- Underground Conduit:
    1. Two 4-inch conduits from Century Link's pedestal to the school's MDF.
        a. 200 pound calibrated mule tape installed inside of each conduit.
        b. One 1.5 inch innerduct with 200 pound calibrated mule tape installed inside of the innerduct.
        c. If the outside end of the conduits is open, that is, not inside closed pedestals or boxes, it shall be capped with a suitable cover so that water and critters cannot get in to the conduit.
    2. One 2-inch conduit from Comcast's pedestal to the school's MDF.
        a. 200 pound calibrated mule tape installed inside of the conduit.
        b. If the outside end of the conduits is open, that is, not inside closed pedestals or boxes, it shall be capped with a suitable cover so that water and critters cannot get in to the conduit.
    3. MDF to temporary modular classroom vault or pad.
        a. One two (2) inch conduit with 200 pound calibrated mule tape installed inside of the conduit.
        b. Location to be coordinated with Division 26 Electrical
        c. If the outside end of the conduits is open, that is, not inside closed pedestals or boxes, it shall be capped with a suitable cover so that water and critters cannot get in to the conduit.

END SECTION 27 05 43

27 05 53 Identification for Communications Systems – August 2015

- Work in this section is open to any product or material meeting the requirements of this Technical Guideline.
- Labeling:
    1. Labeling is required to clearly and legibly identify all components of the communications system including but not limited to: Racks, punch fields, cables, patch panels, and jacks.
    2. The labeling system in the closets for backbone cable shall designate the cable's origin and destination and a unique identifier for the cable within the system.
    3. Racks and patch panels shall be clearly and legibly labeled to identify the location within the cabling system infrastructure.
    4. Horizontal cables shall be clearly and legibly labeled within 2 inches of the end of the jacket at both the patch panel end and the jack end of the cable.
    5. The faceplate of the jack at which horizontal cables are terminated in the classroom, office, or work area shall be clearly and legibly labeled with the same cable number as the jack on the patch panel.
    6. All labeling information shall be recorded on the as-built drawings and all test documents.
    7. The District's labeling standard for each cable and face plate is as follows:
        a. The second position denotes the closet where services originate; the MDF is always "0" and "1", "2", "3"' etc. represent the various IDF rooms.
        b. Thus, the first data cable in the MDF would read D-0-1, the second cable would read D-0-2 and continue numerically on the patch panel. The first data cable in the third IDF would read D-3-1, the second D-3-2, etc.

END OF SECTION 27 05 53

27 08 00 Commissioning of Communications General Cable Testing – August 2015

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
- General Cable Testing
    1. All cables and termination hardware shall be tested to detect defects in manufacture and installation and to verify cable performance after it has been installed.
    2. The contractor shall verify that ALL conductors of EACH cable are usable prior to system acceptance.
    3. Testing can be completed by the installing contractor; third party testing is not required.
    4. Any defect in the cabling system installation including but not limited to cable, connectors, feed through couplers, patch panels, and jacks shall be replaced, not repaired.
    5. If testing is performed by the contractor a report shall be submitted by the contractor identifying the tests performed, results of the tests, and performance data resulting from the tests, including performance data for all drops. This shall be submitted prior to the punch-list phase of the project.
- Installation Warranty:
    1. The contractor shall warrant the cabling system against defects in materials, installation methods, and workmanship for a period of no less than one year from the date of system acceptance.
    2. The warranty shall cover all labor and materials necessary to correct any defective portion of the system and to demonstrate performance within the original installation specifications after repairs are completed.
- Cable Plant Warranty:
    1. The contractor shall issue a warranty on the installed cable plant, which guarantees materials, installation methods, and workmanship on all components used in the system for no less than one year from the date of acceptance.
    2. The warranty shall guarantee a minimum of 350 MHz for all Cat 6 cables.
    3. The warranty shall guarantee a minimum of 100 MHz for the backbone copper cables.

4. The multimode fiber optic portions of the cabling system shall be guaranteed to a minimum of ten (10) Gigabits per second for runs of less than 300 meters (982.4 feet). Multimode fiber optic cable runs of greater than 300 meters shall be guaranteed to run at up to one (1) Gigabit per second.

- Copper Cable Testing:
    1. Testing can be completed by the installing contractor; third party testing is not required.
    2. If testing is performed by the contractor a report shall be submitted by the contractor identifying the tests performed, results of the tests, and performance data resulting from the tests, including performance data for all drops. This shall be submitted prior to the punch-list phase of the project.
    3. The continuity of each conductor of every cable shall be tested.
    4. Twisted-pair cables shall be tested for continuity, cable length, proper installation, pair reversals, shorts, opens, and data performance.
    5. The test shall be recorded as pass/fail as indicated by the test set in accordance with the manufacturers recommended procedures, and associated with the appropriate cable identification number and circuit or pair number.
    6. Any faults in the wiring shall be corrected and the cable re-tested prior to final acceptance.
- Copper Data Cable Length:
    1. The installed length of each Category 6 cable shall be measured from termination point to termination point using an automated test device.
    2. The length of any Category 6 cable shall be no longer than 90 meters (295.2 feet). This means the actual total overall length of each contiguous fixed cable itself, NOT the linear distance between, for example, the jack and the IDF.
    3. Cable lengths shall be recorded, and associated with the cable identification number and circuit or pair number.
    4. For multi-pair cables, the longest pair length shall be recorded as the length of the cable.
- Copper Performance Verification:
    1. The actual performance of each cable shall be tested using an automated test set.

2. Category 6 cable test results shall be automatically evaluated using the most up to date criteria from the ANSI/EIA/TIA-568C 1-2 standards.

3. Test results shall be printed directly from the test unit or from a download file using an application from the Test equipment manufacturer.-
4. The printed test results shall include all tests performed, the expected test result and the actual test result achieved.
5. If testing is performed by the contractor a report shall be submitted by the contractor identifying the tests performed, results of the tests, and performance data resulting from the tests, including performance data for all drops. This shall be submitted prior to the punch-list phase of the project.

- Fiber Optic Testing:

1. Testing can be completed by the installing contractor; third party testing is not required
2. Multimode optical fiber terminations shall be tested in accordance with ANSI/EIA/TIA-568-B.3-H.
3. Panel to panel and panel to outlet multimode fiber optic cables shall be tested in accordance with ANSI/EIA/TIA-568-C.1-2 and ANSI/EIA/TIA-526-14,
4. All test jumpers shall be the same fiber core size and connector types as the cable system.
5. When testing, the light source or Optical Time Domain Reflectometer must operate in accordance with ANSI/EIA/TIA-526-14A for multi-mode fiber optic cable.
6. If testing is performed by the contractor a report shall be submitted by the contractor identifying the tests performed, results of the tests, and performance data resulting from the tests. This shall be submitted prior to the punch-list phase of the project.

- Inspection Phases:

1. The ITPM and PM shall make periodic inspection of the project in progress. Such inspections do not relieve the Contractor from the responsibility of meeting the specifications.
2. One inspection shall be performed at the conclusion of cable pulling, prior to closing of the ceiling to inspect the method of cable routing and support, and the fire-stopping of penetrations.
3. A second inspection shall be performed at completion of cable termination to validate that cables were dressed and terminated in accordance with

ANSI/TIA/EIA specifications for jacket removal and pair untwist, compliance with manufacturer's minimum bend radius, and that cable ends are dressed neatly.

- Final Inspection:

  1. Upon completion of the project, the PM shall perform a final inspection of the installed cabling system with the vendor's project foreman. This inspection does not relieve the Contractor from the responsibility of meeting the specifications.
  2. The final inspection shall be performed to validate that all horizontal and backbone cables were installed as defined in the drawing package, and that the installation meets the aesthetic expectations of the District.

- Test Verification and System Performance:

  1. If testing is performed by the contractor a report shall be submitted by the contractor identifying the tests performed, results of the tests, and performance data resulting from the tests, including performance data for all drops. This shall be submitted prior to the punch-list phase of the project.
  2. Upon receipt of the test documentation, consisting of the printed test results of each cable tested, the District reserves the right to perform spot testing of a representative sample of the cabling system to validate test results and that the cable meets specifications.
  3. Printed test results shall identify each cable tested and match installed cable designations.
  4. If significant discrepancies are found, the vendor shall be notified for resolution.
  5. During the four-week period between final inspection and delivery of the test and as-built documentation, the District may activate the cabling system to validate operation.

- Final Acceptance:

  1. Final acceptance shall not occur until all of the following are complete:
  2. Installation, in-progress, and final inspections are complete.
  3. The District has received and verified the test and as-built documentation.
  4. The cable has performed successfully for a four-week period.

END SECTION 27 08 00

27 11 00 Communications Cable and Equipment Rooms – August 2021

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
- General:

  1. The Main Distribution Frame (MDF) room is where the Century Link and other service provider cables from the outside connect to the inside building cable plant. Intermediate Distribution Frame (IDF) rooms are the telephone closets inside the building. Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, IT Infrastructure Department; see Section 27 05 10 for the list of acceptable materials.

- Backboards:

  1. The MDF and IDF room cable termination backboards shall be solidly attached to the walls of the room as follows:
  2. New, unused, unpainted plywood.
  3. Fire-retardant treated.
  4. Size: ¾" x 48" x 96"
  5. Provided by General Contractor.

- Racks:

  1. Racks shall be securely attached to the concrete floor using ½ inch bolt hardware.
  2. Racks shall be grounded and/or bonded to the telecommunications ground bus bar in accordance with current NEC codes, provided by Electrical Contractor.
  3. Left over rack mount screws (#12-24) not used for installing fiber panels and other hardware shall be screwed into the rack in open spaces for future use and left with the rack upon completion of the installation.
  4. Termination fields shall be mounted per Data, Communications and Alarm Diagram.

- Acceptable Patch Cable Colors:

  1. Blue patch cables are to be used for devices requiring a typical data connection such as printers, copiers, credit card readers, etc.

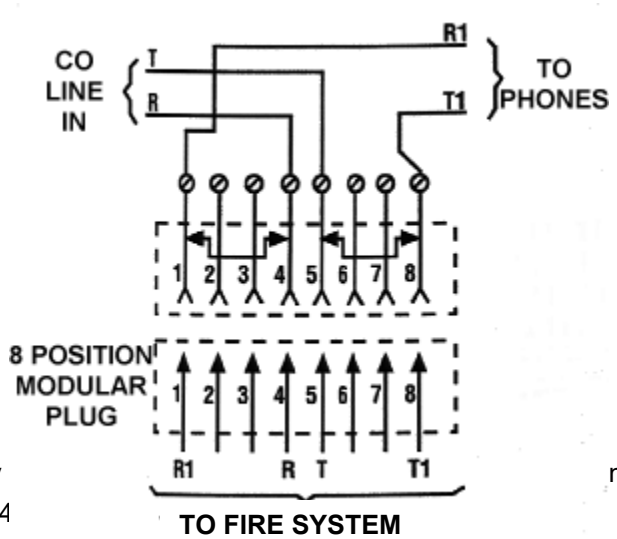
2. Purple patch cables are to be used for all power over Ethernet telephones only.
3. Black patch cables are to be used for all power over Ethernet wireless access point devices only.
4. Brown patch cables are to be used for cameras only.
5. All listed cable colors are to be used for designated devices only and should be a minimum length of 5 feet.

- Coordination:

1. All material shall be supplied and installed by the pre-qualified vendor.

- Voice Termination:

1. Any voice communications that are VOIP carried on CAT 6 cable terminated to a data patch panel are considered Data Cable and shall use the Data Cabling and Termination specifications below.
2. Voice cross connects for POTS lines shall be made by the District's Telecommunications Staff.
    a. If additional 66 blocks are required, they shall be installed by the District's Telecommunications Staff.
    b. Frames shall be oriented so that backbone frames are located on the left and horizontal frames are located on the right of the termination field when facing the backboard.
    c. Cross-connects and cross-connect wire shall be provided by District's Telecommunications Staff.
3. Where specified, RJ31x jacks shall have the following pinout:



- Data Cabling and Termination:
    1. Data cables in the MDF and IDFs shall terminate into rack-mounted Category 6 data patch panels.
    2. Horizontal data and voice cabling shall be connected using patch cords from the horizontal Category 6 data patch panels to the network equipment within the same or adjacent racks.
    3. Horizontal data and voice patch panels shall be contained in 19” x 7’ rack(s).
    4. All equipment racks shall include horizontal and vertical management hardware, both front and rear, to properly and neatly dress horizontal cables and patch cords.
    5. Patch panels shall be fully loaded 24 or 48 modular jack ports, wired to T568B.
    6. Patch panels shall be fully loaded and equipped with horizontal management panels (front) and cable support bars (rear), to properly and neatly dress, terminate, and manage the installed cables and provided patch cords.
- Installation Requirements:
    1. Copper termination and management hardware shall be installed in the following manner:
        a. Pair untwist at the termination shall not exceed one-quarter inch for Enhanced Category 6 connecting hardware.
        b. Bend radius of the cable in the termination area shall not be less than 4 times the outside diameter of the cable.
        c. Cables shall be neatly bundled and dressed to their respective panels or blocks.
        d. Each panel or block shall be fed by an individual bundle separated and dressed back to the point of cable entrance into the rack or frame.
        e. The cable jacket shall be as close as possible to the termination point.
        f. Each cable shall be clearly labeled on the cable jacket behind the patch panel.
    2. Communications Cable Management, Data Racks and Ladder Racks:
        a. The COM rooms shall have racks, ladder racks and required cable

mounting hardware.

b. The MDF shall have a minimum of 2 racks.

c. Each IDF shall have a minimum of 1 rack.

d. Racks shall be placed in a manner that shall allow for clearance of 4 ½ feet in the back and 3 feet in front.

e. If one mounting rail of the rack is placed against a wall, the mounting rail shall be no closer than 6 inches from the wall to allow room for vertical management.

f. Multiple racks shall be placed side by side with room for vertical wire management with 6 inches between wire management.

g. MDF and IDF layout must be reviewed and approved by ITPM at DD, CD, and pre-construction.

END SECTION 27 11 00

27 13 00 Communications Backbone Riser Cabling – August 2021

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
- Backbone cabling connects the MDF to the various IDF rooms, and sometimes IDF rooms to other IDF rooms. Backbone cabling is also sometimes called vertical cabling, cross-connect cabling, riser cabling, or inter-closet cabling. Backbone cabling consists of not only the cables that connect the telecommunications rooms, equipment rooms, and building entrances but also the cross-connect cables, mechanical terminations, or patch cords used for backbone-to-backbone cross-connection.
- Backbone riser cables shall be unbroken with no splices between the MDF and the final IDF. That is, if a backbone riser cable passes through an intermediate IDF to get to its final termination IDF room, the unbroken cable shall simply pass through the intermediate IDF; it shall not be cut or spliced.
- Communications Copper Backbone Cabling:
    1. The standard for voice backbone cabling shall be 24 AWG 25-pair Category 3 rated unshielded twisted pair.
    2. The cable shall meet UL 1581 VW-1 fire safety standard.
    3. The cable shall Meet ANSI/EIA/TIA 568-C.2, ISO/IEC 11801 performance requirements.
    4. Grounding shall meet the requirements as defined in J-STD-607-A, the Commercial Building Grounding and Bonding Requirements for Telecommunications.
    5. The pathways and spaces to support backbone cabling shall be designed and installed in accordance with the requirements of TIA-569-C.1-2. Care must be taken when running backbone cables to avoid sources of EMI or radio frequency interference.
    6. Voice backbone cables shall be terminated on wall mounted Telco split 66 punch down blocks.
- Communications Optical Fiber Backbone Cabling:
    1. One orange 62.5/125 12-strand multimode armored and plenum rated fiber optic backbone cable shall be installed from the data MDF to each of the IDFs.
    2. A fiber warning label shall be attached to the cable every 24 feet.

3. Fiber slack shall be neatly coiled within the fiber termination panel. No slack loops shall be allowed external to the fiber panel.
4. Fiber slack shall be neatly coiled within the fiber termination panel. No slack loops shall be allowed external to the fiber panel.
5. Each cable shall be individually attached to the respective termination panel by mechanical means. The cable's strength member shall be securely attached the cable strain relief bracket in the panel.
6. Each fiber cable shall be stripped upon entering the termination panel and the individual fibers routed in the termination panel.
7. Each cable shall be clearly labeled at the entrance to the termination panel. Cables labeled within the bundle shall not be acceptable.
8. Dust caps shall be installed on the connectors and couplings at all times unless physically connected.
9. All individual fibers shall be terminated with LC connectors on both ends.
10. Fiber optic cables shall be terminated in the data MDF and IDFs in rack mount patch panels.
11. Providing protection to the terminated fibers.
12. The enclosures shall provide CommScope (or equivalent) "Paired LC" interfaces. Rack mounted optical fiber enclosures shall support up to 24-ports in a one rack unit (1.75") space.
13. Each patch panel shall have a slide out tray, which slides forward to allow easy access to the fibers for maintenance and installation.
14. The District requires fiber to be installed using an armored plenum product; therefore, the use of inner-duct is not necessary.

END SECTION 27 13 00

27 15 00 Horizontal Communications Cabling – August 2015

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.

    1. Horizontal cabling runs from the MDF or IDF to the classroom, office, or work area. Horizontal cabling include the following:
        a. all horizontal communications cable shall be Cat 6.
        b. Outlet jacks in the office, classroom, or work area must be rated the same as the cable; Cat 6 rated jacks for Cat 6 cable.
        c. Cable supports

- Materials:

    1. Indoor plenum-rated four pair Cat 6 unshielded twisted pair, 23 AWG solid copper-stranding cable with rip cord. The cable shall meet or exceed the following standards:
        a. NEC/(UL) Specification CMR
        b. NEC Article: 800
        c. NFPA 70
        d. ISO/IEC 11801 Class E performance requirements
        e. CMP (NFPA 262, UL 910)
        f. ISO/IEC 11801 ed 2.1 (2008) Class D
        g. Category 6 - TIA 568.C.2
        h. NEMA WC-63.1 Category 6, UL Verified to Category 6
        i. UL Flame Test: UL 1666 Vertical Riser
        j. C(UL) and CSA Flame Test: FT4
        k. IEEE Flame Test: 1202

- Cat 6 cable shall be terminated in the classroom, office, or work area telecommunication outlet to a Cat 6 rated RJ45 jack with correct matching cover plate.
- Cat 6 cable shall be terminated in the communications closet to a 24 or 48-port Cat 6 rated rack-mounted patch panel.
- Installation Requirements:

    1. The cable jacket shall be as close as possible to the termination point.
    2. See Section 27 05 53 for labeling requirements.
    3. Both ends of the cable are to be terminated in the T568B configuration.

END SECTION 27 15 00

27 16 00 Communications Connecting Cords, Devices and Adapters – August 2022

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by Jefferson County School District, R-1.
- Telecommunication Outlets
    1. Each Cat 6 cable in the office, classroom, or work area locations specified on the plans or drawings shall be terminated with a Cat 6 rated RJ45 jack.
    2. Each CAT 6 cable shall be terminated on an 8-position, 8-conductor CAT 6 Universal jack.
    3. Jack faceplates shall be mounted into single or dual gang boxes. Box eliminators, surface mount boxes and floor monuments shall be provided by the electrical sub-contractor.
- Modular Furniture Outlets:
    1. The faceplate shall be the one specified by the modular furniture manufacturer.
    2. Faceplates shall be mounted in the appropriate knockouts in the furniture channel.
- Wall Outlets:
    1. Wall plates shall be front loading CommScope Uniprise SL Series.
    2. Each jack shall be labeled in accordance with Section 27 05 53.
    3. The faceplate label shall be covered by a clear plastic insert.
    4. CommScope part numbers per Section 27 05 10.
        a. Single-gang Faceplate, white color
        b. Dual-gang Faceplate, white color
        c. Quad-gang faceplate, white color
        d. Blank, 1.5 Unit Module, almond color
        e. F-Connector Insert for Module
        f. LC Connector Insert for Module
        g. Blank Insert for Module
- Installation Requirements:

1. Cables shall be coiled and supported in the ceiling if adequate space is present to house the cable coil without exceeding the manufacturer's specified bend radius or cable tension.
2. No cable shall be placed on ceiling tiles.
3. No more than 12" of slack shall be stored in a wall box, modular furniture raceway, or insulated walls. At no time shall any cable exceed the manufacturer's specified bend radius or cable tension.
4. Excess slack may be neatly coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable.
5. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/EIA/TIA-568-B document.
6. Pair untwist at the termination shall not exceed one-fourth inch for Category 6 connecting hardware.
7. Bend radius of the cable in the termination area shall never be less than four times the outside diameter of the cable.
8. The cable jacket shall be as close as possible to the termination point.

- Communications Patch Cords, Station Cords and Cross Connect Wire:
  1. See Section 27 05 10 for the list of acceptable materials
  2. Patch cords used at the data rack and at the workstation shall be rated the same as the horizontal cable, Category 6, as appropriate.
  3. Patch cords shall be factory-assembled by the manufacturer of the cable.
  4. Each workstation shall require one Enhanced Category 6 patch cord.
  5. At the patch panel, the contractor shall provide patch cords to connect network equipment to the correct jack cable.
  6. For every jack installed by the contractor, there shall be a patch cord rated the same as the cable, Cat 6, as appropriate, with an RJ45 connector on each end supplied by the contractor. There shall be an equal number of 3, 4, and 6 foot cords provided.
  7. In the workstation area, 6, 10, and 12-foot patch cords shall be provided in equal amounts of each length.
  8. Vendor shall provide stock of each size patch cord.
  9. Each wireless access point location shall require one 2-ft. Enhanced Category

6 patch cable.

- Wireless Access Point Communication Cabling:

1. Provide Category 6 cable in the ceiling in the center of each specified room, terminated with a plenum-rated surface mount box.
   a. To facilitate the current and future wireless local area network, the contractor shall pull a new Category 6 cable to the center of the ceiling or specific location. Each cable shall be terminated with a plenum rated surface mount box.
   b. The District Project Manager will identify classrooms, office spaces, and common areas that require the installation of a WAP.
      (1) The final wireless design drawings shall be reviewed and approved by a District Wireless Engineer.
   c. Surface mount boxed shall be neatly and legibly labeled above the ceiling with the drop number corresponding to the patch panel number.
   d. All wireless AP's must have a label with data jack number of the cable to which it is attached. The cable drop number shall be neatly printed in a large enough font size on the wireless access point in a location that can be easily seen by someone standing on the floor below the wireless access point.
   e. Terminate the cable in a new CAT 6 patch panel in the nearest data closet MDF or IDF. Leave ten feet (10-ft.) of service loop above the ceiling in the classroom or office for future flexibility and a six foot (6') service loop in the data closet.
   f. All cables shall be tested and the test results provided to the District Project Manager.
   g. Although every classroom and some office and common areas shall have a cable in the center of the ceiling, not all rooms shall initially get a wireless access point device. District Project Manager shall specify the rooms in which wireless access point devices are to be installed.
   h. Classrooms that are notated to have data installed for future WAPs should have a green dot placed on the ceiling grid below the area where the cable is terminated.
   i. The District shall provide all wireless access points. The vendor will be required to install the wireless access points at the direction of the District unless otherwise noted.
   j. Normally the devices will be new in a box, however, there may be situations where the devices have been previously installed. The vendor shall install these wireless access point devices in accordance with the manufacturer's instructions in the locations specified by the District.
   k. All outside wall penetrations shall have a sleeve, bushing and shall be

weather-tight.

l. The cabling contractor/vendor shall provide a Category 6 plenum rated 2- ft. patch cord for each wireless access device location.

END SECTION 27 16 00

27 16 50 Video Projector Cabling Mounting – August 2017

- Work in this section is restricted to specific products of specific manufacturers that have been previously approved by the District; see Section 27 05 10 for the List of Acceptable Materials. Work in this section is limited to vendors that have been pre-approved through the Audio/Video bid.
- Acceptable Installation and Wiring Methods:

    1. General:

        a. All are to be installed to manufacturer's instructions.

    2. Electrical cord from projector must plug in at either a duplex outlet at 84" AFF next to the location of the wall mount arm or below the smart board into an outlet within 24" of the device.

- Lightspeed Topcat audio system.

    1. 955 Access System with Flexmike, Sharemike, (1) TCA multimedia ceiling speaker

    2. Topcat 955 Access Media Connector sound system with paging interrupt and speaker. This installation is most commonly a ceiling mount installation.

- Installation Requirements:

    1. Cables shall be coiled and supported in the ceiling if adequate space is present to house the cable coil without exceeding the manufacturer's specified bend radius.

    2. No cable shall be placed on ceiling tiles or light fixtures.

    3. All cable shall be supported to structure via the use of a beam clamp with an appropriately sized saddle or Arlington loop.

    4. No more than twelve inches (12") of slack shall be stored in an in-wall box, modular furniture raceway, or insulated walls, and the cable must never exceed the manufacturer's specified bend radius.

    5. Excess slack may be neatly coiled and stored in the ceiling above each drop location when there is not enough space present in the outlet box to store slack cable, but the coil may NOT rest on a light fixture.

    6. Cables shall be dressed and terminated in accordance with the recommendations made in the ANSI/EIA/TIA-568-C document,

manufacturer's recommendations, and best industry practices.

7. Pair untwist at the termination shall not exceed one-fourth inch (1/4") for Category 6 connecting hardware.
8. The Bend radius of the cable in the termination area shall never be less than four times the outside diameter of the cable.
9. The cable jacket shall be maintained as close as possible to the termination point.

- Interactive Board Installation Height Specifications:
  1. Kindergarten through 3rd Grade – The top of the board shall be 74" AFF
  2. 3rd Grade through 6th Grade – The top of the board shall be 77" AFF
  3. 7th Grade through 12th Grade – The top of the board shall be 80" AFF
  4. Short throw assemblies (arm and projector) shall be installed 1 to 2" above the Smart board or whiteboard leaving minimum 80" from the floor to the bottom of the projector
- Warranty:
  1. The contractor shall warrant that all products, materials, and installation are guaranteed to be free from defects in material, installation procedure, and workmanship after final acceptance of installation, for the period defined in the provisions of the District Technical Guidelines.
  2. If requested, the Installer shall make up to three (3) on-site visits without additional cost to the District to make system adjustments during the first year. The first year begins on the date of final acceptance, and ends 365 days later.
  3. On-premise maintenance shall be provided at no cost to the District, unless damage or failure is caused by misuse, abuse, neglect, or accidents.

END SECTION 27 16 50

27 51 13 Paging System (Mass Notification System) – August 2021

Note: This section is presented in its entirety. It is suggested that the engineer cut and paste from this section to create a project specific specification section edited for each project.

SECTION 27 51 13 PAGING SYSTEM

PART 1 - GENERAL

A. Paging system shall be defined as a mass notification system, and will be installed building wide. This system may be zoned.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1. Division 26 Sections

1.3 SUMMARY

1. This Section includes equipment for amplifying, distributing, and reproducing sound signals on up to nine output channels separately or as an all call.

1.4 DEFINITIONS

1. Channels: Separate parallel signal paths, from sources to loudspeakers or loudspeaker zones, with separate amplification and switching that permit selection between paths for speaker alternative program signals.

1.5 PERFORMANCE REQUIREMENTS

A. System Functions: Include the following:

B. The Terms "Listed" and "Labeled": As defined in the latest adopted version of the National Electrical Code.

C. Selectively connecting separate zones to different signal channels.

D. Paging system shall override and/or mute existing performance sound systems such as gyms, auditorium, cafeteria, weight rooms, wrestling rooms, and other rooms as necessary.

E. Communicating simultaneously to all zones regardless of zone or channel switch settings.

F. Paging by dialing an extension from any local telephone instrument and speaking into the telephone.

G. Producing a program-signal tone that is amplified and sounded over all speakers, overriding signals currently being distributed.

H. Reproducing high-quality sound that is free from noise and distortion at all loudspeakers at all times during equipment operation, including standby mode with inputs off; and output free from non-uniform coverage of amplified sound.

1.6 SUBMITTALS

A. Product Data: For each type of equipment.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, required clearances, method of field assembly, components, and location of each field connection.

1. Console layouts.

2. Control panels.

3. Rack arrangements.

4. Wiring Diagrams: Detail wiring for power, signal, and control systems and differentiate between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance. Include a single-line diagram showing cabling interconnection of components. (MDF 66 block wiring diagrams with paging zone connections and IDF 66 block wiring diagrams with paging interconnecting wiring diagrams of connections to the MDF).

5. System Installation Diagrams: Showing all speaker locations, wiring routes used to each speaker, identification of cable and wiring pair used at each speaker, and end termination.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements. Include record of final speaker-line matching transformer-tap settings, and signal ground-resistance measurement certified by Installer. Provide certification of completion of installation and service training. Include calculations, charts and test data necessary to demonstrate that the system components deliver the specified signals and power levels at the required points and locations.

D. Maintenance Data: For equipment to include in maintenance manuals specified in Division 1.

1. Four copies of complete operational instructions shall be furnished complete with record drawings.

2. Include part numbers and names, addresses and telephone numbers of parts source.

1.7 QUALITY ASSURANCE

A. The contractor shall be an established communications and electronics contractor who has had and currently maintains a locally run and operated business for at least five consecutive years.

B. The paging system must provide satisfactory sound levels in all areas of the school, inside and outside, where installed.

C. It must be capable of processing paging inputs from the school's telephone system and from the system's administrative phone (direct connected) installed in the school's office area.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

E. Comply with NFPA 70.

F. Comply with UL 50.

1.8 CAPABILITIES

A. Elementary and Middle School Systems must be capable of:

1. Paging all speakers at the same time.

2. Separately page each of the 2 individual zones of the school (Zone Page), as identified by the District.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Paging System Manufacturers: Subject to compliance with requirements and interface with existing facility equipment, products that may be incorporated into the work shall be as manufactured by Bogen Company:

B. Paging System: Bogen PCM-2000 System to include the following:

1. Power Supply: PCM-PS2, 1 each per school
2. Telephone Interface Module: PCM-TIM, 1 each per school
3. Central Processing Module: PCM-CPU, 1 each per school
4. Zone Module: PCM-ZPM, 2 each per school

C. Desk Set Telephone: 2500 located in office, 1 each per school with direct connection to the paging system

D. Inside Speaker Amplifiers: Bogen TPU-250

1. Elementary Schools: 1 each per school
2. Middle Schools: 2 each per school
3. High Schools: 3 each per school

E. Outside Horn Amplifiers:

1. Either 1 ea. Bogen TPU-250 or 1 ea. Bogen TPU-100 depending on outside horn quantity

F. Uninterruptible Power Supply (UPS):

1. 1400VA, 1200 Watt stand-by power – 1 each per school TrippLite SMART1500TSU

2.2 PAGING SYSTEM EQUIPMENT

A. Coordinate features to form an integrated system. Match components and interconnections for optimum performance of specified functions.

B. Equipment: Modular type, using solid-state components, fully rated for continuous duty, unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 Hz.

C. POWER AMPLIFIERS

1. Comply with EIA SE-101-A.
2. Mounting: Wall mounted.
3. Output Power: 25Volts, 250Watts.
4. Frequency Response: Within plus or minus 2 dB from 50 to 12,000 Hz.
5. Minimum Signal-to-Noise Ratio: 60 dB, at rated output.
6. Total Harmonic Distortion: Less than 3 percent at rated power output from

50 to 12,000 Hz.

7. Output Regulation: Less than 2 dB from full to no load.

D. SPEAKERS: Paging speakers: Mixture of lay-in (ceiling), speaker/clock combinations, flush-mounted paging horns, surface-mounted paging horns, and wall surface mounted speakers as required in the various locations:

1. Ceiling Lay-in speakers: Valcom Clarity S-521B (5 watt)
2. Preferred installation at existing and at all new installations where acoustical suspended ceilings occur.
3. Speaker/clock combination speakers: Bogen S86T725 Existing systems only
4. Surface-mounted speaker horns: Bogen SPT-15A Gymnasiums, Cafeterias, Auditoriums, and exterior Include wire-guards for Gymnasiums.
5. Flush-mounted horn with backbox: Bogen FMH15T Horn with BBFM6 Backbox.
6. Wall-mounted speakers: Bogen WBS8T725 Existing conditions and areas without suspended ceilings
7. Surface ceiling mounted speakers: Bogen MB8TSQ with rough-in can and baffle Existing conditions
8. Pendant Mount Speakers: SoundTube RS62-EZ (Black or White)
   (a) For open ceiling areas.

E. SPEAKER WIRE: 2 Conductor 20 AWG, CMP, Bare Copper (BC), Twisted, Stranded, Gray or White.

1. Acceptable Manufacturers:
   (a) Beldon 6400UE
   (b) West Penn 25222B
   (c) Approved Equivalent
2. When speaker wires terminate in an IDF, extend to the MDF using 25 pair cable. Install wire labels on both ends of each wire/cable installed.

F. TELEPHONE INTERFACE MODULE (TIM):

1. Arranged to accept voice signals from telephone system (extension dialing

access) to automatically provide amplifier input and broadcast through paging speakers in preselected zones.

G. MOUNTING:

1. Install as per details shown on the drawings. Wall mount amplifiers and auxiliary equipment on a plywood backboard in a neat organized manner. All cables shall be bundled, supported on the backboard, and routed in neat vertical and horizontal lines.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install equipment to comply with manufacturer's written instructions. System shall be capable of an all system speaker page as well as an individual zoned page for each of the paging zones identified in the drawings.

B. Paging System Wiring Method: Each speaker shall be wired in the system by a continuous homerun to the MDF or IDF in the vicinity of the speaker. Connect new paging system to building speakers using existing wiring where possible. Arrange wiring and terminations to create zones as indicated on the drawings or as directed by school personnel. Speakers will not be daisy-chained in the plenum except for speakers in Corridors. All other speakers will have their own cable running to the closest IDF or MDF room. Outside speakers must be homerun to nearest IDF or MDF.

C. Terminate wiring from the speakers in the MDF/IDF on the A-B side of a 66 block (see Division 27). Extend speaker wires that are first terminated in an IDF to the MDF from the C-D side of the 66 block and terminate on the A-B side of the 66 block in the MDF. Use bridge clips for connection from the A-B side of the 66 blocks to the C-D side. Connect the outputs from the paging system to the C-D side of the 66 blocks in the MDF.

D. Extend one pair of paging system wires from the paging system to each of the performance sound systems for emergency override, wherever they occur. Wires are not to be terminated at the sound systems, label each end of each pair as to their purpose.

E. Extend one 20/2 cable from the paging system to the master clock for time/tone interface.

F. System cabling shall be supported by cable support (per Div. 27) above ceilings, where ceilings exist, and tight to structure where structure is exposed. Drop cable at speaker location. Provide conduit sleeves where cable penetrates walls, and provide fire seal for all penetrations through fire rated barriers.

G. Paging speakers shall be set for 25volt operation and adjusted or tapped as follows:.

1. Hall speakers: 1 watt
2. Room speakers: ½ watt
3. Gym speaker horns: 15 watt
4. Cafeteria speakers: 2 ½ watt
5. Outside speaker horns: 7 ½ watt
6. Install head end equipment in the MDF as shown on the drawings

H. Identification of Conductors and Cables:
1. Apply wire and cable marking tape (see Div. 26) to designate wires and cables to identify media in coordination with system wiring diagrams. Provide labels for all existing cables at termination points where labels do not exist.

I.Identify and label with approved final room designations.

J. Label all 66-blocks. Label room numbers or termination points on 66-block. Provide a laminated 66-block diagram for each 66-block with the final room designations or termination points, attached to the wall above the 66-blocks.

K. System shall be separated into 2 zones: Inside (Zone A on 1st ZPM module [Zone 1])

L. Outside (Zone B on 1st ZPM module [Zone 2]) 2nd ZPM is a Spare

3.2 GROUNDING

A. Ground cable shields and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Signal Ground Terminal: Locate at main equipment cabinet. Isolate from power system and equipment grounding.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled components and equipment installations, including connections. Report results in writing.

B. Operational Test: Perform tests that include originating program and page material at microphone inputs, preamplifier program inputs, and other inputs. Verify proper routing and volume levels and freedom from noise and distortion.

C. Commissioning: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging speaker-line matching transformers.

D. Provide all required testing apparatus and factory-trained personnel specified to successfully complete the test. (Third party testing is NOT required).

E. Prior to energizing or testing the system, ensure the following:

1. All products are installed in a proper and safe manner per the manufacturer's instructions.
2. Insulation and shrink-tubing are present where required.
3. Dust, debris, etc., are removed
4. Cable is dressed, routed and labeled, connections are consistent with requirements
5. All labeling has been provided
6. Electronic devices are properly grounded

F. 25V Speaker Test:

1. Play music or other distinctive audio signal through all speakers.
2. Walk all rooms and other speaker locations.
3. Verify that each speaker is operating and that there are no significant changes in volume levels from one speaker to the next.
4. Verify that the extent of coverage is consistent with the areas indicated on the drawings.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain equipment as specified below:

B. Provide one 2-hour session to train Owners maintenance personnel and a total of two hours - to train school staff on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining equipment. Include proper use of the system which covers operation using the telephone system and the administrative phone

1. Review data in maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
2. Schedule training with Owner, through Engineer, with at least seven days' advance notice.

3.5 WARRANTY

A. The contractor shall warrant that all materials and installation shall be guaranteed to be free from defects in material and workmanship after final acceptance of installation for the period defined in the provisions of Division 01.

END SECTION 27 51 13

27 51 16 Public Address Sound Systems – August 2021

- Work in this section is restricted to specific products of specific manufacturers and model numbers that have been previously approved by Jefferson County School District, R-1.
- Section Includes:
    1. Public Address Rooms:
        a. Independent sound system for public performances and meetings in:
            (1) Gymnasium
            (2) Multipurpose room
            (3) Auditorium
            (4) Vocal Music
            (5) Instrumental Music
            (6) Commons
            (7) Cafeteria
- See Data, Communications and Alarm Diagram.
- In the absence of other information, standards of the following organizations apply:
    1. Electrical Components complying with applicable requirements of NFPA 70 "National Electrical Code" including, but not limited to:
        a. Article 250, Grounding
        b. Article 300, Part A., Wiring Method
        c. Article 310, Conductors for General Wiring
        d. Article 725, Remote Control, Signaling Circuits
        e. Article 800, Communications Systems
    2. Underwriters Laboratories (UL) 50 as applicable.
- Submittals
    1. Product Data: Required
        a. Equipment prints

b. Full electronic wiring diagrams

c. Specification sheets including cable types.

2. Shop Drawings: Required

a. Detailed wiring diagrams for power, signal and control that clearly differentiate between manufacturer installed wiring and field installed wiring.

b. Identify wires at termination points to facilitate installation, operation and maintenance.

c. Detail programmable electronic communications network system including but not limited to the following:

(1) Detailed One Line Drawings

(2) Equipment Cabinet Arrangement

d. System field wiring diagrams showing typical connections for all equipment.

e. Manufacturer's complete service notes and drawings detailing all interconnections.

f. Riser diagram for the system showing in technically accurate detail all connections and interconnections.

g. Test Reports:

(1) Include calculations, charts and test data necessary to demonstrate that the system components deliver the specified signals and power levels at the required points and locations.

3. Certificates:

a. Copy of UL listing cards for the proposed system

b. A signed statement from the equipment supplier that the system has been wired, tested and functions properly according to the specifications.

4. Manufacturer Instructions:

a. Four copies of complete operational instructions shall be furnished complete with record drawings.

b. Include part numbers and names, addresses and telephone numbers of

parts source.

5. Commissioning:

    a. Submittals listed above, updated to record status.

6. Demonstration and training:

    a. Provide a factory authorized representative to present a 2-hour demonstration on site to the school staff about the major features, common functions and routine operation of each component.

    b. Present one in-depth 2-hour session of technical classroom training, on- site, by a factory trained representative of the equipment manufacturer for selected District technicians on the functions, trouble diagnosis and proper maintenance of the installed equipment.

    c. Furnish each member of the class a copy of the manufacturers' applicable training manuals.

    d. Schedule the demonstration and training sessions with the District project manager at least ten days in advance.

7. Warranty

    a. Guarantee all materials and installation to be free of defects in material and workmanship after final acceptance of installation for the period defined in the provisions of Division 01.

    b. Provide on-the-premise maintenance at no cost for the warranty term.

    c. Within one year of date of acceptance, provide up to three on-site assistance visits to adjust sound levels, reset matching transformer taps and adjust controls to suit actual occupied conditions.

- Maintenance

    1. Local service by factory-trained personnel of the specified equipment from an authorized distributor of all equipment specified under this section.

- Amplifier

    1. Crown Dual Channel or approved equivalent.

    2. No greater than 19 inches wide, 5 inches high and 26 inches deep.

    3. Audio output of a minimum of 250 watts RMS with a total harmonic distortion of .05% maximum at 1 kHz rated power.

        a. Output regulation .5 dB (direct); 1.0 dB (Transformer).

4. Amplifier must meet load requirements

- Mixers

1. Behringer RX1202FX or Soundcraft Ui-16
2. Complete input and mixing facilities for minimum 8 low impedance microphone inputs and auxiliary inputs.
3. Auxiliary programs input such as CD players and recorders are considered as part of this guideline.
    a. Include CD player with BlueTooth with remote control (IR).
        (1) Product previously approved by Jefferson County School District, R-1 is Tascam CD-200BT with the IR control.
4. Complete input and mixing facilities for microphone inputs and auxiliary inputs
    a. Input overload circuit which permits microphone signals of up to 1 volt to be reproduced without any discernible increase in distortion.
    b. Capable of reproducing microphone signal levels above 1 volt magnitude without overloading; or rely upon a gain switch to accommodate high signals

- Signal Processor:

1. Elementary School
    a. Shure DFR22
        (1) Include all circuitry and controls necessary to provide complete system equalization for optimum sound reproduction and maximum gain before feedback.
            (a) Equalizer filters: 1 octave bandpass type having an individual range of 12 dB.
            (b) Front and back panels will have user lockout controls.
2. Middle School and High School
    a. Shure DFR22 or Symetrix or QSC Core Processors depending upon system design
        (1) Include all circuitry and controls necessary to provide complete system equalization for optimum sound reproduction and maximum gain before feedback.

(2) Equalizer filters: 1 octave bandpass type having an individual range of 12 dB.

b. Front and back panels will have user lockout controls

- Speakers:

1. Sound Tube HP890i, HP129a, or CM800i, or District approved equivalent.

   a. Monitors: EV-SX300/MB200 or District approved equal.

2. Self-contained loud speakers manufactured by manufacturers previously approved by Jefferson County School District, R-1.

3. Numbers of speakers used depend on the physical area to be covered.

4. All hanging speakers will have a minimum of two support cables, rated to support 10 times the speaker weight.

5. All Elementary and Middle School Gymnasiums will utilize hanging speakers manufactured by SoundTube; model number will depend on the area to be covered.

6. High School Gymnasiums and High School & Middle School Auditoriums will utilize horn-loaded speaker cabinets. Number and size of speakers used will depend on physical area to be covered.

- Microphones:

1. Handheld microphones:

   a. Shure SM58LC

   b. With stand and 25 foot microphone cable each.

2. Wireless microphones systems:

   a. Audio Technica ATW 3000 series or Shure SLXD / ULXD or Sennheiser G4 Series.

   b. Two (2) per stage and gymnasium.

3. Hanging microphones:

   a. Shure MX 202BP/C

   b. Three (3) per stage.

4. Microphone jacks:

   a. Non-latching Female XLR

(1) Switchcraft Model D3FD or approved equivalent

b. Flush mounted.

- Power Conditioner and Sequencer

1. Furman Model Furman CN-2400S

a. Keyed off/on switches

b. Standard rack mountable

- Cables

1. Speaker Circuits

a. Homerun station wiring in individually jacketed cables

b. Cables 14 AWG conductors; plenum rated

2. Microphone cables:

a. Minimum of 22 AWG, plenum rated and each jack homerun to sound cabinet

3. All microphone jacks will be Switchcraft Model D3FD Non-Latching or District approved equal.

- Equipment Rack:

1. Acceptable products:

a. Middle Atlantic DWR-35-22

b. Lowell LWBR-3532

2. Wall mount, swing-out with front locking door

3. Louvered front

- Source Quality Control

1. Listed by Underwriter's Laboratories under UL Standard 1459.

2. All items of equipment, including wire and cable, shall function as a complete system.

3. Experimental equipment will not be acceptable.

4. The proposed system must be demonstrable at a local customer’s facility.

- Execution Summary

1. Install system in a well-ventilated location with adequate heat rejection and in accordance with NFPA 70, other applicable codes, and manufacturer's written instructions.
2. Provide necessary transient protection on the AC power feed to the system.
3. Install low voltage wiring within cable supports above accessible ceilings and in raceways where Inaccessible or in exposed areas.
4. Install in conduit within inaccessible ceiling and wall spaces.
5. Use UL listed plenum cable.
6. Do not install system cabling and high voltage wiring within the same raceway.
7. Carefully match input and output impedances and signal levels at signal interfaces.
8. Provide matching networks where required.
9. Provide adequate length of conductors within enclosures.
10. Neatly bundle, tie and trim the conductors to terminal points with no excess.
11. Provide 12 inch minimum separation between cables to speaker-microphones and adjacent parallel power and telephone wiring.
12. Make splices, taps and terminations on numbered terminal punch blocks in junction, pull and outlet boxes, terminal cabinets and equipment enclosures.
13. Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams
14. Cable supports are mandatory where routed through plenum ceiling areas.

- Grounding
    1. Equipment grounding connections are required for communications network systems rack.
    2. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.
    3. Ground equipment and cable shields to eliminate shock hazard and to minimize to the greatest extent possible ground loops, command mode returns, noise pickup, cross talk and other impairments.
- Installation Schedule

1. Individual schools may vary depending on design and layout.
2. Typical Elementary Gym/Stage:

Quantity	Component
4	SoundTube HP890i-WH Speakers (Gym)
2	SoundTube CM-800i Ceiling Speakers (Stage)
1	Behringer RX1202FX Rack Mixer or Soundcraft Ui-16
1	Crown CDi-1000 Power Amplifier
1	Shure DFR22 Signal Processor
2	Shure SM58S Microphones
3	Shure 202BP/C Microphones (for stage)
3	25’ Microphone Cables
2	Audio Technica ATW-3212/C510 Handheld Wireless
1	Audio Technica ATW-R3210 Body Pack
1	Audio Technica BP894xCH-TH
1	Middle Atlantic DWR-35-22
1	Middle Atlantic VFD-35
1	Middle Atlantic UD2
1	Furman CN-2400S Power Sequencer
2	Round Base Mic Stand
2	Boom for mic stand
1	ART AVDIBox
1	3.5mm Cable
1	Tascam CD-200BT
1	RDL ST-VP2 Automatic Ducking Module
1	RDL PS24A Power Supply
1	RDL TX-70A Paging System Interface
4	Horizon SP-1NC3FD-L-1-0 Wall Plate (non-latching XLR wall plate)

1	Horizon Rack Panel w/4 Non-Latching XLR Jacks
1	Xantech WL85 J-Box IR Receiver
1	Xantech 789-44PS/RP Connecting Block w/PS
1	Xantech 283D Emitter

3. Typical Elementary Cafeteria:

4	SoundTube CM-800i Celing Speakers
1	Behringer RX1202FX Mixer
1	Crown CDi-1000 Power Amplifier
1	Shure DFR22 Signal Processor
2	Shure SM58S
3	25’ Microphone Cables
2	Audio Technica ATW-3212/C510 Handheld Wireless
1	Audio Technica ATW-R3210 Body Pack
1	Audio Technica BP894xCH-TH
1	Middle Atlantic DWR-35-22
1	Middle Atlantic VFD-35
1	Middle Atlantic UD-2
1	FurmanCN-2400S Power Sequencer
2	Round Base Mic Stand
2	Boom for Mic Stand
1	ART AVDIBox
1	3.5mm Cable
1	Tascam CD-200BT
1	RDL ST-VP2 Automatic Ducking Module
1	RDL PS24A Power Supply
1	RDL TX-70A Paging System Interface
2	Horizon SP-1NC3FD-L-1-0 Wall Plate

1 Horizon Rack Panel w/4 Non-Latching XLR

1 Xantech WL85 J-Box IR Receiver

1 Xantech 789-44PS/RP Connecting Block w/PS

1 Xantech 283D Emitter

4. Typical Middle School Gyms: Same as Elementary School Gyms with the following exceptions:

   9 SoundTube HP890i-WH speakers No

   SoundTube CM-800i speakers

   No Shure MX202-BP/C Microphones

5. Middle School Cafetoriums: Same as Elementary Gyms with the following exceptions:

   5 SoundTube HP890i-WH speakers

6. High School system components are designed for each facility's needs. Coordinate with the District Project Manager.

- Acceptable Installer

  1. Installation and start-up are required to be under the direct supervision of a local contractor meeting the following criteria:

     a. Regularly engaged in installation, repair and maintenance of such systems.

     b. Established sound systems, communications and electronics contractor that has had, and currently maintains, a locally run and operated business for at least five years.

     c. Local authorized distributor of all specified equipment for a single source of responsibility and shall provide documents proving such.

     d. Provide written proof that his firm is adequately staffed with factory- trained technicians for all of the specified equipment.

- Acceptable Supplier

  1. Factory authorized distributor meeting the following criteria:

     a. Full responsibility to honor the manufacturer's warranty.

b. Show satisfactory evidence, upon request, that the supplier maintains a fully equipped service organization capable of furnishing adequate inspection, training and service to the system.

c. Availability of necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

d. Accredited by the proposed equipment manufacturer(s) and prepared to offer a service contract for system maintenance on completion of the warranty period.

e. Provide the names, locations and cite five recent successful installations in the area.

- Field Quality Control

1. Provide the services of a factory authorized service representative to supervise the field assembly, connection of components and the testing and adjustment of the system.

2. Check-out and final connections to the system shall be made by a factory trained technician in the employ of the manufacturer of the products installed.

END SECTION 27 51 16

27 51 30 Classroom Sound Reinforcement System – August 2017

- Permanently Installed Systems
  1. New and Major Renovations
- Portable Systems
  1. Existing Areas
- Acceptable Manufacturers:
  1. Lightspeed
     2. Basis of Design:
        a. 955 Access System with Flexmike, Sharemike, (1) TCA multimedia ceiling speaker
        b. Topcat 955 Access Media Connector sound system with paging interrupt and speaker. This installation is most commonly a ceiling mount installation.
- Installation: Manufacturer certified or approved installers.
- Warranty: 1 year
- Testing and Commissioning: Prior to acceptance, test full range of all systems with District Project Manager present. Ensure system does not interfere with other facility components, such as PA system, wireless systems, and others.
- Training: Provide complete system training to District School and Maintenance Staff, including operation and maintenance.
- System shall function without audible distortion, hum, buzz, or rattle under normal operating conditions.
- System Components (Permanently Installed Wireless System)
  1. General:
     a. Speaker system with flat panel technology and multimedia speaker mounted in ceiling with wireless media connector.
     b. Media Connector with power supply. Wireless audio transceiver powered with USB connector. Wireless communications access technology shall be coordinated with other wireless communications access technologies present in the facility to avoid interference and conflict. Tone control with audio inputs and audio outputs.
  2. Speaker amplifier with power supply
     a. In-ceiling wireless audio base station with power supply.
     b. Wireless media connection: Coordinate with other wireless communications access technologies present in the facility to avoid interference and conflict.
  3. Controls:
     a. Master microphone volume control, tone control, audio input volume control connections:
        - Direct AC main power input, optional DC power input, audio input

- Optional page mute input

4. Pendant Microphone
    a. Pendant-style audio transceiver with lanyard and wireless communication.
    b. Audio distortion < 1%
    c. Rechargeable battery pack and charging cradle and cable
    d. USB connection for charging and audio, or other as approved
    e. On/Off/Mute switch
    f. Push button for registration with system wireless components
5. Shared microphone
    a. Handheld audio transceiver with wireless communication technology and integral rechargeable battery pack.
    b. Audio distortion < 1%.
    c. Uni-directional microphone
    d. Audio input
    e. Charging jack
    f. On/Off/Mute switch
    g. Push button for registration with system wireless components
    h. Cradle charger for shared microphones
    i. Capacity: 2 microphones

- System Components (Portable Systems):

1. Lightweight and portable plug-and-play tabletop system consisting of an audio base station with speaker. Built-in wireless or blue tooth capabilities. Portable microphones.
    a. Pendant Microphone: Pendant-style audio transceiver with lanyard and wireless communication. Audio distortion < 1%. Rechargeable battery pack and charging cradle and cable. USB connection for charging and audio, or other as approved. On/Off/Mute switch. Push button for registration with system wireless components.
    b. Shared microphone: Handheld audio transceiver with wireless communication technology and integral rechargeable battery pack. Audio distortion < 1%. Uni-directional microphone. Audio input. Charging jack. On/Off/Mute switch. Push button for registration with system wireless or blue tooth components. Cradle charger for 2 shared microphones.

END SECTION 27 51 30

27 53 13 Clock and Program Systems – April 2020

- System Description:
  1. An integrated, system for originating and distributing time and time correction signals and for programming and initiating audible program signals. Components display time at various locations, provide programmed audible signals, and operate remote switching. The system transmits time and program signals from a master control unit to indicating clocks, signal equipment, and remote switching devices over clock and program system wiring.
  2. A basic wireless timekeeping system:
     a. System controller
     b. Built-in or external transmitter
     c. Transmitter antenna
     d. Means of receiving time synchronization (Ethernet SNTP) analog or digital clocks
     e. Components for expanding the system and its operations
        (1) Capable of synchronizing clocks and computers throughout the facility on a daily basis.
  3. Installation Locations: Typical locations identified in the District Technical Details Drawings.
- System Synchronization:
  1. System shall synchronize all clocks to each other. System shall utilize Ethernet (SNTP) technology to provide atomic time to components.
     a. Systems for new school facilities shall not require hard wiring for its components except for AC power.
     b. Systems for existing facilities must interface with existing wired clock systems.
     c. Clocks shall automatically adjust for Daylight Saving Time per the Daylight Saving time settings in the system controller.
     d. Analog Clocks shall synchronize to +/- 1 second of the master clock displayed time.
- System Requirements:
  1. The system shall include an internal real time clock reference so that failure of

the SNTP signal shall not cause the clocks to fail in indicating the correct time.

2. The system shall incorporate a “fail-proof” design so that a temporary power interruption shall not cause failure of the system. Upon restoration of power, the system shall resume normal operation.
3. Analog clocks shall be battery operated or 110VAC powered. (unless 24VAC already exists onsite)
4. System shall include a minimum of 4 relays, in addition to the clock relays, to control inside and outside bells and other devices.
5. System instruction manual and equipment shall be available for building site transmitter signal reception diagnosis.

- Quality Control:
  1. System manufacturer and vendor shall be responsible for a complete and operating system, including constructability, functionality and maintainability of the system components.
  2. Manufacturer must be able to provide:
     a. Battery operated Wireless Analog clocks
     b. AC powered 120v Wireless Analog and Digital clocks
     c. AC powered 24v Wireless Analog clocks
  3. Training: On-site system training from a qualified factory representative to include troubleshooting. Include both maintenance and end user. Provide operation and maintenance manual.
- Regulatory Requirements:
  1. System Controller, Transmitter, and Receiver shall comply with Part 90 of FCC rules as follows:
     a. Devices must not cause harmful interference.
     b. Transmitter frequency shall be governed by FCC Part 90.35
     c. Transmitter output power shall be governed by FCC Part 90 and 74.
  2. System shall be installed in compliance with Authorities Having Jurisdiction.
- Submittals:
  1. Product Data: Submit complete catalog data for each component describing physical characteristics and method of installation.

2. Shop Drawings: Complete set of project-specific shop drawings showing wiring and components, including one-line diagram of major system components. Include notes from on-site investigations for existing systems.

3. Manufacturer's Instructions: Submit written instructions for a complete installation, set-up, and operations & maintenance data.

- Master Clock – System Controller:
  1. System Controller shall be equipped with a wired clock system run and correction output circuits and correction protocols for select wired clock systems. System controller can simultaneously operate a wired clock system and provide wireless clock signal to maintain synchronization of the wired and wireless clock systems throughout a facility.
  2. Approved Manufacturers:
     a. American Time (ATS)
     b. Sapling, Inc.
  3. System Controller shall synchronize to Ethernet via SNTP.
  4. Master Clock shall be able to transmit clock correction wirelessly to secondary clocks

  5. Wireless transmitters may be internal or external.

     a. Transmitter:

        (1) Frequency Range: multiple frequencies acceptable but are specific to manufacturer.

        (2) Transmission Range: To include all clocks associated with a building and campus.

        (3) Transmission format: POCSAG, digital one-way communication

        (4) Digital Data rate: 512 - 2400BPS

        (5) Operating range: 0 to 45 degrees C (32 to 114 degrees F)

  6. Interface with existing wired clock systems

     a. 3-Wire Synchronous clocks (code 01)
     b. National Movement (code 18)
     c. Frequency generated systems
  7. Ethernet connection
     a. System Controller shall be capable of remote web interface which allows for event and circuit programming as well as manual circuit activation via a web browser without the need for special software.
        (1) Include triggering wired and wireless events
        (2) Assigning custom durations to signals

(3) Managing programming of up to six (6) circuits, backing up and restoring schedules to and from PC's
(4) Activating circuits manually
(5) Ability to monitor and adjust Daylight Savings Time remotely

b. Shall have the ability to remotely control schedules for relays (bells) via network
c. Shall have the ability to manually ring the bells remotely
d. Shall have the ability to remotely control master clock setup and master clock functions.

8. System controller shall incorporate a display and a keypad to provide the following features:
   a. Password protected Administrator menu to set the date, local time zone, clock addresses, and other system parameters
   b. Time zone selection via the keypad and display for all USA time zones.
   c. Automatic Daylight Saving Time Adjustment can be enabled or disabled from keypad.
   d. Database programming and administration using its keypad and LCD display
   e. The system controller shall contain an internal clock such that failure of reception from the SNTP will not disable the operation of the clocks.
9. Antenna:
   a. For indoor or outdoor applications. Antenna polarization per manufacturer's recommendation.
   b. Install clock antenna as far away from Paging System head end as possible to avoid interference.
10. Power supply: (included with master):
    a. Manufacturer's Recommendation

- Devices:
  1. Direct wired electrical devices with on/off capability or momentary signaling.
  2. Analog Clocks:
     a. 15" diameter (at Assembly locations), 12" diameter all other locations
     b. Black Case
     c. Wall Mounted
     d. Polystyrene frame and polycarbonate lens.

e. Face shall be white.

f. Hour and minute hands shall be black, second hand is red.

g. Misc. clock features:

(1) Analog clocks with no user mechanical adjustments.

(2) Run time of a half hour after power loss without losing time for AC versions.

(3) Time shall be automatically updated from the transmitter with a minimum of 1 time per day.

(4) Use manufacturers recommended batteries or AC power adapter without battery.

h. The clock shall have an ultra-sensitive receiver and integrated internal antenna.

i. The clock will keep operating using its internal quartz clock in case of signal reception loss due to malfunction of the wireless system controller or transmitter.

3. Digital Clocks:

a. 4 or 6 digit (with approval of District Project Manager), 4" high red LED character display with built-in wireless receiver.

b. Operate off of 110VAC.

c. Manufacturer shall have digital clocks that operate as a countdown/message clock along with displaying normal time.

4. Wireless Relay Module:
   a. For use where wireless signals are utilized.
   b. Manufacturer shall be able to provide both low voltage and high voltage remote relays that receives a wireless signal and supplies a contact closure based on the schedule in the system controller that is assigned to that circuit.

- Acceptable Components
  1. ATS
     a. Master Clocks
        (1) SSQMSTR-05N8E – Site Sync 5-watt master clock with Ethernet, 2 wired clock circuits and 6 bell circuits
        (2) SSQMSTR-10N8E – Site Sync 10-watt master clock with Ethernet, 2 wired clock circuits and 6 bell circuits
        (3) SSQMSTR-10C8E – Site Sync 10-watt master clock with Ethernet, 2

wired clock circuits and 6 bell circuits, campus antenna

b. Wall Clocks
   (1) SQ55BADD504BP – 12” Molded Battery Wireless Clock
   (2) SQ55BAAD504 – 12” Molded 120vac Wireless Clock
   (3) SQ55BABD504 – 12” Molded 24vac Wireless Clock
   (4) SQ65BADD504BP – 15” Molded Battery Wireless Clock
   (5) SQ65BAAD504 – 15” Molded 120vac Wireless Clock
   (6) SQ65BABD504 – 15” Molded 24vac Wireless Clock

2. Sapling
   a. Master Clock
      (1) SMA-3S0-1004-1 – Master Clock with 4 Bell Relays
      (2) SMA-3S0-1008-1 – Master Clock with 8 Bell Relays
   b. Wall Clocks
      (1) SAL-4BS-12R-0 – 12” Battery Wireless Clock
      (2) SAL-4BS-12R-14 – 12” 120vac or 24vac Wireless Clock (specify 120vac or 24vac)
      (3) SAL-4BS-15R-0 – 15” Battery Wireless Clock
      (4) SAL-4BS-15R-0 – 15” 120vac or 24vac Wireless Clock (specify 120vac or 24vac)

END SECTION 27 53 13

27 53 19 Bi-directional Antennas – August 2022

- Bi-directional Antenna systems utilized to support local first responders and provide uninterrupted on-site emergency communications

- Coordinate requirements with local authorities having jurisdiction
- Coordinate with the District's Information Technology and Communications department through the District's Project Manager
- Components:
  1. Bi-directional amplifier (BDA)
     a. Radio Frequency amplifiers
        i. Some jurisdictions may require multiple BDA's
     b. Antenna system located in the interior of the building
        i. Multiple antennas or "leaky COAX" cabling as approved by the local jurisdiction
        ii. Donor antenna mounted on the building's roof to receive signals from a carrier radio tower
     c. Mounting sled for roof antenna with weather-resistant weights
     d. COAX cable for antenna connections (interior and exterior)
     e. Connectors
     f. Uninterrupted power supply (UPS)
        i. NEMA fire-rated UPS enclosure
     g. Splitters and Combiners
        i. Signal splitters and combiners

END SECTION 27 53 19

SECTION 28 05 00

COMMON FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Cable Material Requirements.

B. Cable Installation Requirements.

1.2 GENERAL REQUIREMENTS

A. The requirements of the Contract Documents, including the General and Supplementary General Conditions, and Division 1 – General Requirements shall apply to work of this Section.

B. At the time of bid, all exceptions taken to these Specifications, any variances to the contract drawing design, and any non-conformance to the operating capabilities called for in this specification, shall be listed in writing and forwarded with the submission of the bid. Any such exception, variance, or non-conformance, which was not listed at the time of bid, and is identified in the submittal, shall be grounds for immediate disapproval without comment.

C. Consultant shall reference District Archives' Composite Floor Plans to verify accuracy of room usage and placarding. The contractor is responsible for providing door placards.

1.3 RELATED SECTIONS

A. Section 07 80 00: Fire and Smoke Protection
B. .
C. Division 08 71 00: Door Hardware

D. Division 26: Common Work Results for Electrical Systems.

E. Division 26: Low Voltage Electrical Power Conductors and Cables.

F. Division 26: Grounding and Bonding for Electrical Systems.

G. Division 26: Hangers and Supports for Electrical Systems.

H. Division 26: Raceways and Boxes for Electrical Systems.

I. Division 26: Identification for Electrical Systems.

J. Division 27: Communications.

K. Division 28: Access Control Security System.

L. Division 28: Video Surveillance Security Systems.

M. Division 28: Fire Alarm and Detection System (New and Existing)

N. Division 28: Security Detection and Alarm Systems (New and Existing)

O. District's Technical Details Drawings – Volume II

1.4 SUBMITTALS

A. Reference Division 01 – Submittal Procedures

1. Product Data: Provide manufacturer's data sheets showing product appearance, electrical characteristics, and connection requirements.
2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use, as stipulated by the product-testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and start-up or products.
3. Exceptions: Provide a details listing of any and all exceptions, variances, and non-conformances to the specifications and contract design drawings. Failure to disclose any such items shall be grounds for immediate disapproval of submittals without comment.
4. Samples: Provide samples of the following items.
    a. Provide a minimum of two (2) samples of all cable to be installed on the projects. Cable samples shall be of sufficient length to identify cable marking (striping) and cable listing identification.
    b. Provide a minimum of two (2) samples of all cable supporting devices, metal bridle rings, metal mounting brackets, plastic plenum rated wire bushings, and other applicable cable installation equipment to be utilized on the project.
5. Card Access\Security Systems Installer: Documented experience and certifications of Installation Supervisor.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum three (3) years' experience, and with service facilities within fifty (50) miles of the project.

B. Fire Alarm Installer: Installing Company shall use only District Approved Premier level Notifier dealer or JCI dealer for programming and final testing. The Bidding Company must specialize in installing the products specified in this section with a minimum three (3) years documented experience. The installer shall employ NICET Level 2 trained technicians to install the products specified in this Section.

C. Card Access\Security Systems Installer: The Installing Company and personnel assigned to the project must specialize in installing the products specified in this section and shall meet, at a minimum, the following:
1. Installer shall be licensed by "City and County of Denver" as Access Control System Supervisor. Minimum experience required as follows:
    a. Three (3) years' experience working in the access control trade with similar type projects..
    b. Experience must be displayed in each of the following disciplines:
        i. Electrical Design and Installation
        ii. Hardware Application and Installation (e.g., maglocks, card readers, electric locks and strikes)
2. Final programming of Card Access/Security System shall be performed by the Owner.

PART 2 - PRODUCTS

2.1 ACCESS CONTROL/SECURITY AND SAFETY ALARM SYSTEM WIRE AND CABLE

A. Cable for Class 1 Remote Control and Signal Circuits: Copper conductor, 600 volts insulation rated 75 degrees C, individual conductors twisted together, shielded, and covered with a non-metallic jacket, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

B. Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volts insulation rated 75 degrees C, individual conductors twisted together, shielded, and covered with a non-metallic jacket, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

C. Miscellaneous Access Control/System Circuits: Power limited fire protective signaling cable for fire and smoke characteristics, copper conductor, 300 volts insulation rated 105 degrees C, UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.

D. Use #18/4 AWG minimum size stranded conductors for security device initiating loop circuits.

E. Provide wet environment exterior rated cable for underground raceway or exterior cable applications.

F. Install all remote control and signal cables in raceways, or supported every 4 to 6 feet on metal bridal rings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Plenum rated cable.

1. Cable routing shall be perpendicular to or parallel to structural building members, and shall utilize a metal bridal ring type support system attached to structural building members only.
2. Mounting cable to other building systems (fire protection, electrical conduit, mechanical ductwork, etc.), or running cable in any fashion other than described, is strictly forbidden.

C. Do not exceed 40% fill rate in raceways and back boxes.

1. For retrofit applications, conduit and box fill shall be assessed and approved by the Engineer and District.

D. Minimum size for back boxes shall be 4" x 4" x 2-1/8" with 512 HD mounting bracket or approved equivalent.

E. Combination speaker/strobe back boxes shall be ORBIT Fire alarm 4S (FA-UMAB) 4" x 4" x 3-1/2" with associated SSB-TBAR or approved equivalent.

F. Adjustable Caddys are not permitted.

G. The use of extension rings on new or retrofit construction shall be approved on a "case-by-case basis" by the Engineer and District.

H. Junction boxes for any new or retrofit construction, that have more than four (4) wire splice connections, shall utilize WAGO connectors (http://www.wago.us/products/2631.htm) , or equivalent as approved by District project manager.

I. Wire runs shall be continuous and shall not contain splices or t-taps unless otherwise approved by Engineer and District.

J. Provide Wiremold© or Plastic surface raceway in all areas that are exposed to the Public. Paint to match existing wall or ceiling finish, unless approved by the Engineer and District. Paint to match existing wall or ceiling finish, unless approved by the Engineer or District. Knockouts are not permitted in exposed back boxes installed in public areas.

K. Electrical junction boxes shall be covered with a red cover plate.

L. Electrical back boxes shall utilize knockouts only as necessary. Unused knockout holes are not permitted.

M. All box knock outs and exposed conduit edges shall have plastic edge protection.

1. Conduit shall be provided in exposed joist construction and concealed spaces. Contractor shall utilize Wiremold© where permitted in writing by Jefferson County for surface mount in locations accessible to the public. Contractor shall obtain approval from Jefferson County or engineer representative for Wiremold© and conduit locations.

2. Conduit shall be provided for all inaccessible spaces and above hard lid ceilings.

3. Conduit shall be provided for all areas where wire would be exposed or unprotected.

4. Conduit shall be in accordance with The National Electrical Code (NEC), local and state requirements.

5. Conduit is not permitted to be secured to the roof deck. All existing conduit utilized for fire alarm shall be removed if improperly secured to the roof deck and new conduit shall be installed. Conduit shall be installed in accordance with NEC spacing requirements from the roof deck.

6. All conduit shall be installed by a licensed electrician.

7. All conduit shall be red, hot-galvanized, fire alarm EMT. Conduit shall be painted to match existing surface if requested by owner.

8. Cable must be separated from any open conductors of power, or Class 1 circuits, and shall not be placed in any conduit, junction box or raceway containing these conductors, per NEC.

9. Conduit shall not enter the fire alarm control panel, or any other remotely mounted control panel equipment or back boxes, except where conduit entry is specified by the FACP manufacturer.

10. Conduit shall be trade size 3/4-inch (19.1 mm) minimum. ½-inch conduit may be allowed if the contractor submits a specific request in writing.

11. Conduit edge protection shall be provided for all transitions from conduit to bridle rings. Reference Open (Plenum) Cable Installation Requirements.

12. Conduit sleeves shall be used for all penetrations through fire rated or non-fire rated walls and partitions. Sleeves through fire rated walls shall be fire caulked on both sides of the wall and filled after cable installation.

13. Knockouts are not permitted in exposed back boxes installed in public areas. Provide and install surface skirts for all surface mounted devices.

N. Support all boxes by All-thread or other approved box support device; or bolt directly to building structural members. Do not support boxes to ceiling tie-wires.

O. Provide marking paint on support hardware. Red for Fire Alarm, Green for Security and card Access systems. Do not allow paint to contaminate any wire.

P. Fire alarm wire contaminated with paint shall be removed and re-pulled. Fire alarm support hardware contaminated with paint [does not apply to approved marking paint (red)] shall be removed and replaced.

Q. Mount end-of-line device in box with last device.

R. Mount outlet box for electric door holder to withstand 80 pounds pulling force. Where wall construction is wood or steel frame, utilize Caddy telescopic bracket TSGB16/TSGB24 or approved equivalent.

S. Division 28 contractor shall make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, duct smoke detectors, smoke/fire dampers, HVAC units, and other applicable devices, furnished under other Sections.

T. Automatic Detector Installation: Conform to NFPA 72.

U. Automatic Duct Detector Installation: Conform to NFPA 90A. When patching ducts, utilize steel plates secured by #8 x ½" indented slotted hex washer head type A sheet metal screws and apply mastic which is listed and labeled "181A-M" in accordance with UL 181A. Do not use tape.

3.2 OPEN (Plenum) CABLE INSTALLATION REQUIREMENTS

A. Wire shall be new, twisted, unshielded FPLP.

B. Each wire shall be labeled with shrink wrap at each junction box and termination. The wire label shall be securely fastened to the circuit and shall indicate in minimum 12 point font typed lettering the circuit type (SLC, IDC, NAC, Power, etc.) in addition to the circuit number matching the as-built documentation. (For example: SLC Loop 1, IDC kitchen hood, IDC waterflow, NAC 1-4 or Power 3.)

C. Open cabling shall be installed in a neat and workmanlike manner, and shall be run perpendicular or parallel to building structural members. Diagonal routing of cable shall not be considered acceptable and shall cause to be removed and reinstalled.

D. Open cabling shall be routed away from other building cabling and equipment, and shall be routed to and from the device in a vertical or horizontal manner. Maintain cabling at the same level where possible, Cabling that is not dropped vertically to the device or routed horizontally

straight to the device shall not be considered acceptable. Cabling that is routed through, over, under or around other equipment, when a straight horizontal or vertical path is available shall not be considered acceptable and shall cause the cable to be removed and be reinstalled.

E. Open cabling shall be supported at a minimum of every 4 to 6 feet to building structural members utilizing metal bridle rings. Cabling that is secured to, or contacting, sprinkler piping, HVAC ductwork, electrical conduit or other non-structural building member shall not be acceptable and shall cause the cable to be re-installed and re-supported in a proper manner.

F. Conduits and device back boxes shall have appropriate plastic plenum rated strain relief wire bushings where open cable routing occurs. Do not use Romex type connectors.

G. Conduits shall be utilized for all separation (wall, ceiling, fire separation barrier, etc.) penetrations.

H. EMT conduit shall be utilized in all wall cavities. Provide appropriate plastic plenum rated wire bushing where open cable routing occurs. Do not use Romex connectors.

I. Surface mount and lighting level devices shall incorporate a wiremold backbox or a device specific backbox skirt.

J. STI backplate shall be utilized for joist mounted devices requiring a wire guard.

K. Appropriate fire caulking or sealant shall be utilized where open cabling penetrations through fire separation barriers or building separation walls occur. Fire caulk all conduit ends where conduit sleeves penetrate fire barrier separations, after cable has been installed. Reference 07 80 00 – Fire and Smoke Protection.

L. Provide wet environment exterior rated cable for underground raceway or exterior cable applications. THHN cable is not acceptable for fire alarm wet locations.

3.3 LABELING

A. All fire alarm devices shall have the room number\location description provided in the software programming. Example [(Device Address) AHU-1 Return Classroom 201]. RPS monitor modules shall have the room number included in the software description. When necessary to distinguish the locations of two or more detectors, compass directions shall be incorporated in the device location description in programming.

B. Label each initiating device with device ID address (Manufacturer's format), and control module or monitor module with device ID address and circuit function [(Device Address), Strobes format]. Use Kroy lettering machine with ¼-inch minimum black lettering on clear background, unless alternate labeling approved by the District. Place label on initiating device base. DO NOT PLACE ON SENSOR.

C. Label each notification appliance with notification appliance circuit number and device number in circuit (Ex: RPS or AMP 1:1-1, RPS or AMP 1:1-2, etc.). Label notification appliance circuit end of line (EOL) device location on the notification appliance where the EOL is located (Ex: RPS or AMP 1:1 EOL). Provide separate label for strobe and speaker circuits. Use power supply and amplifier designations for notification labels. Use Kroy lettering machine with ¼-inch minimum black lettering on clear background, unless alternate labeling approved by the District.

D. Open cabling shall be installed in a neat and workmanship-like manner. Contractor shall utilize plenum rated, red Velcro. Velcro shall be utilized only to avoid obstructions and to secure the service loop in the bridal ring (utilize electrical tape to manage service loop). Zip ties are NOT

acceptable.

E. Label each remote duct detector or beam detector test station with device ID address and associated HVAC unit or beam detector designated [(Device Address) RTU-1 format]. Label location of the device associated with the test station, if the test station is not in the direct vicinity of the associated device [(Device Address) RTU-1 Classroom 201 format]. Use Kroy lettering machine with ¼-inch minimum black lettering on white background, unless alternate labeling approved by the District.

F. Label each concealed device location with device ID address and HVAC unit or module function [(Device Address) AHU-2 Duct Detector or (Device Address) Door Holder Class Rm 201 format] at the adjacent ceiling tile grid T-bar. Use plastic laminate with engraved ¼-inch lettering. Laminate shall be of red on white core construction (white lettering on red background), unless alternate labeling approved by the District.

G. Label each power supply with power supply designation and function. Use plastic laminate with engraved ¼-inch lettering. Laminate shall be of red on white core construction (white lettering on red background), unless alternate labeling approved by the District.

H. Label circuit terminations in panels and junction boxes with shrink wrap type written labels.

I. Label each security device with device ID address (ID # format), and motion detector, keypad, card reader, etc. with device ID address and circuit function with ¼-inch minimum black lettering on white background, unless alternate labeling approved by the District. All motion detectors shall also have the Contact ID Zone number on the label.

J. Contractor shall provide and install door frame placards to match facility assessment. The door frame placards shall reflect the MAPPS room designation and shall be engraved phenolic labels with white text on a black or dark brown background, 1.5” tall by 3” wide and attached to the latching corner of the door frame (sticky back and screwed). Rooms with multiple entries shall have a placard for each entry. Remove outdated or incorrect signage on door frames.

   1. Reference Division 10 Signage for additional information.

3.4 ACCESS CONTROL/SECURITY WIRE AND CABLE COLOR CODE

A. Provide access control system conductors with insulation color coded as

   1. Power Branch Circuit Conductors
      a. Black, red, blue, white, green
   2. Card Reader (In/Out) Circuit
      a. 6/ C #22 minimum with overall shield, stranded (Wire size will change depending on intended wire run length)
      b. White jacket with green striping
   3. Motion Detector Circuit
      a. 4/C #, stranded
         i. Run wires to each device on the polling loop. No individual wire run may exceed the lengths given in the table to follow. In addition, no more than 64mA may be drawn on any individual wire run. When a star configuration is used, the total length of all wire runs combined cannot exceed 4000 ft (2000 ft. if using unshielded wire in conduit or shielded wire). Twisted-pair is

recommended for all normal wire runs.

b. Maximum Polling Loop Wire Runs
    i. Wire Gauge Max. Length
    ii. #22 gauge 650 feet
    iii. #18 gauge 1500 feet
    iv. #16 gauge 2400 feet
c. When running polling loop wires, they must not be run within 6" of AC power, telephone, or intercom wiring. Since the polling loop is carrying data between the control panel and the devices, interference on this loop can cause an interruption of this communication. The polling loop can also cause outgoing interference on the intercom or phone lines. If this spacing cannot be achieved, shielded wire must be used. (Note that the maximum total wire length supported is cut in half when shielded wire is used.)
d. White jacket with green striping

4. RS-485 Data Circuit
    a. 2-Pair #18 with overall shield, stranded
    b. White jacket with green striping
5. Ethernet TCP/IP network cable
    a. Shall be CAT-6, maximum distance based on industry standards
    b. White jacket with green striping
6. Door Strike Circuit
    a. 4/C #18 stranded
    b. White jacket with green striping
7. Request-to-Exit (RX) Motion Detector Circuit
    a. 6/C #20 twisted pair with overall shield, stranded
    b. White jacket with green striping
8. Door Position Switch Circuit
    a. 4/C #22 with overall shield, stranded
    b. White jacket with green striping
9. Security Keypad Circuit
    a. Wiring to the Keypads
        i. Determine wire gauge by referring to the wiring length/gauge chart below.
        ii. Wire keypads to a single wire run or connect individual keypads to separate wire runs. The maximum wire run length from the control to a keypad, which is homerun back to the control must not exceed the lengths listed in the table.
            a) Wire Run Length Table
            b) Wire Gauge Length
            c) #22 gauge 450 feet
            d) #18 gauge 1100 feet
            e) #16 gauge 1750 feet
        iii. The length of all wire runs combined must not exceed 2000 feet when unshielded quad conductor cable is used (1000 feet if unshielded cable is run in conduit or if shielded cable issued).
        iv. If more than one keypad is wired to a run, then the above maximum lengths must be divided by the number of keypads on the run (e.g., the maximum length is 225 feet if two keypads are wired on a #22 gauge run).
        v. White jacket with green striping
10. Future Data Circuit Spare to each Card Access Door (CAD)
    a. CAT-6 cable
    b. White jacket with green striping
    c. Leave cable coiled in the accessible ceiling space above the RX motion detector.

3.5 VIDEO SURVEILLANCE WIRE AND CABLE COLOR CODE (specific conductor and shielding requirements will be per system manufacturer)

A. Video cameras will use CAT-6 (UTP) Circuit:

1. 1 CAT6 to each camera. All cameras and cabling shall be installed by PRE-APPROVED Data and Security Vendors. Contact District Project Manager for current approved vendor list.
2. Refer to Division 27 for cable requirements. (Recommended manufacturers current UTP distances shall prevail)
3. All cameras shall be IP Cameras wired with network drops to the closest MDF\IDF patch panel per Division 27.

B. Camera Power Circuit:

1. All cameras shall be powered via POE.
2. Exterior cameras shall be equipped with Lightning Suppression

C. Ethernet TCPIP network cable

1. CAT-6, maximum distance based on industry standards.

3.6 FIRE ALARM WIRE AND CABLE COLOR CODE

A. Provide Fire alarm system conductors with insulation color codes as:

1. SLC Circuit: 16AWG, Red Jacket with preprinted SLC (every foot)
2. IDC Circuit: 16 AWG, Red Jacket with Brown Stripe
3. 24 VDC Power Circuit: 14AWG, Red Jacket with Purple Stripe
4. Notification Appliance Circuit (NAC):
    a. NAC Strobe only Circuit: 14AWG, Red Jacket with Green Stripe
    b. NAC Speaker only Circuit: 16 AWG, Red Jacket with Blue Stripe
5. Network Circuit: 16AWG, Red with Yellow Stripe
6. Relay Circuit: 16AWG, Red with Yellow Stripe
7. Remote Test Station Circuit: 16AWG, Red with Yellow Stripe
8. Miscellaneous Fire Circuit: 16AWG, Red with Yellow Stripe
9. Fire alarm wire shall be one pair [Red (+)/Black (-)].
10. Remote test station wire can be two pair [Red (+)/Black (-) and Yellow (+)/Green (-)]
11. Left hand lay shall be a minimum of 4.
12. Conductor sizing and numbers subject to equipment manufacturer recommendations.
13. Fire alarm wire shall be unshielded unless required by manufacture.
14. All 120VAC shall meet NEC standards.

3.7 DEDICATED CIRCUIT

A. The fire alarm control panel shall be connected to a separate dedicated emergency branch circuit, maximum 20 amperes. This circuit shall be labeled at the main power distribution panel as FIRE ALARM. Fire alarm control panel primary power wiring shall be 12 AWG. The control panel cabinet shall be grounded securely to either a cold-water pipe or grounding rod.

B. Provide dedicated circuits for amplifiers and power supplies.

3.8 FIELD QUALITY CONTROL

A. Access Control/Security System

1. Test in accordance with District requirements
2. Provide forty-eight (48) hours prior notice to the Engineer and District personnel for rough inspection, prior to installing ceiling tiles or drywall.
3. Provide seven (7) day prior notice to the Engineer and District personnel for scheduled contractor pre-testing of the Security and Safety alarm system.
4. Provide two (2) detailed record of the pre-testing of the system; one for the District and one for the facility's Security System logbook. Pre-testing record must contain a minimum of the device ID, proper device description, proper functionality of the device (panel notification, door unlock, etc.), and date of the testing. Utilize the standard District form available on the District website, or provide Contractor equivalent form approved by the District in advance of the system pre-test.
5. Access Control/Security System Contractor shall sub-contract the Services of a current PRE-APPROVED IDenticard Authorized Factory Partner Level Dealer to provide the access control/security system equipment, panels, enclosures, device terminations, and system programming.

B. Fire Alarm System

1. Test in accordance with NFPA 72, District, State, and Authority Having Jurisdiction (AHJ) fire department requirements. Use District Record of Completion and Pretesting forms included in section 28 46 00.
2. Provide forty-eight (48) hours prior notice to the Engineer and District personnel for rough inspection, prior to installing ceiling tiles, devices or drywall.
3. Provide seven (7) day prior notice to the Engineer and District personnel for scheduled contractor pre-testing of the system.
4. Provide three (3) day prior notice to the Engineer and District personnel for the scheduled Authority Having Jurisdiction (AHJ) testing of the system.
5. Provide three (3) original copies of the NFPA 72 - Certificate of Completion Form.
    a. One for the District, one for the Authority Having Jurisdiction (AHJ), and one for the facility's Fire Alarm System Logbook.
    b. Voltage and current values must be true measured values not estimates.
    c. Provide a table list of each Horn/Speaker location with actual measured dB per NFPA
6. Provide two (2) detailed records of the pre-testing of the system.
    a. One for the District and one for the facility's Fire Alarm System logbook.
    b. Pre-testing record must contain a minimum of the device ID, proper annunciator description, proper functionality of the device (audible/visual signaling, shutdown, etc.), and date of the testing.
    c. Utilize the standard District form available on the District website, or provide Contractor equivalent form approved by the District in advance of the system pre-test.
7. Fire and Security Alarm Contractor shall be responsible for coordination and employing the Controls Contractor to accomplish programming required between Fire and Security Alarm system and Building Automation system as well as connection of all interface circuits.

3.9 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

B. Include services of certified technician to supervise installation, adjustments, final connections,

and system testing.

C. Provide two (2) hard copies and two (2) electronic copies in flash drive format of the final system programming. One set to be delivered to the District Project Manager for the District Central Reporting System programming, and one set to be left at the facility.

3.10 DEMONSTRATION

A. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.11 TRAINING

A. Provide the services of a factory-certified service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. On-Site Training: Provide a minimum of two (2) hours of on-site training of the facility's school staffing in the basic operations and functionality of the access control / security system panel, and field devices. Review field panel locations, typically device locations, and 120vAC power locations (panels, breakers, and circuits). Demonstrate the various system responses to the field off-normal conditions. Simulate card access conditions, supervisory conditions, security conditions, trouble conditions, and ground fault conditions of the various field devices. Demonstrate how to reset various building systems (HVAC units, fire doors, security gates, etc.). Provide written instructions of basic system operating instructions in Fire Alarm Log Book, located adjacent to the fire alarm control panel.
    a. On-Site System Training shall be completed within six (6) days of completion of the system and Owner Acceptance of the system.
    b. Schedule on-site training with the District at least three (3) days in advance.
2. Off-Site Training: Provide a minimum of eight (8) hours of off-site training of the District's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, programming, and preventative maintenance of a system. The off-site training shall be conducted in a classroom type setting, with the content approved by the District in advance. Provide maintenance, service, and programming manuals of the various components of the system. Provide a working (panel and field devices) system demonstration unit; whereby the various system troubleshooting and servicing procedures can be adequately performed in a "hands-on" scenario.
    a. Off-Site System Training shall be completed within thirty (30) days of completion of the system and Authority Having Jurisdiction (AHJ) test and/or final Owner Acceptance of the System, unless the District specifically directs and alternate training schedule.
    b. Schedule Off-Site Training with the District at least fourteen (14) days in advance.

END OF SECTION

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SECTION 28 13 00
ACCESS CONTROL SECURITY SYSTEM

PART 1 – GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the Contract Documents, including the General and Supplementary General Conditions, and Division 1 – General Requirements shall apply to work of this Section.

1.2 SCOPE

A. Scope of Work for the Electronic Security Contractor (SC) shall consist of furnishing all labor, equipment, wiring, supplies, and materials, unless otherwise specified, necessary for the installation of a complete Access Control System (ACS) as required by the specifications and as shown on the drawings, subject to the terms and conditions of the contract. The Work shall also include the completion of those details of work not mentioned or shown which are necessary for the successful operation of the ACS System.

1. Final programming shall be by Owner.

B. The ACS System shall consist of, but is not limited to, the following types of equipment.

1. System Workstation (Existing workstations provided by the District.)
2. Door Control Panel(s).
3. Ethernet Network Converter(s).
4. Centralized Electronic Lock Power Supply(ies).
5. Proximity Card Readers.
6. Electronic Door Locks.
7. System Cabling.
8. Door Contacts.
9. Request to Exit Devices.
10. Fire Alarm, Security and Paging System Interfaces as required.

C. SC shall provide and install all conduit, standard back-boxes, and 110VAC power circuits as necessary. SC shall install and “local” (at door location) dedicated electronic lock power supplies, as required.

D. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section. The District Guideline “Data, Communication, and Alarm Diagram” shall also apply to this section.

1.3 RELATED SECTIONS

A. Division 07: Fire and Smoke Protection

B. Division 08: Door Hardware.

C. Division 26: Common Work Results for Electrical Systems.

D. Division 26: Low Voltage Electrical Power Conductors and Cables.

E. Division 26: Grounding and Bonding for Electrical Systems.

F. Division 26: Hangers and Supports for Electrical Systems.

G. Division 26: Raceways and Boxes for Electrical Systems.

H. Division 26: Identification for Electrical Systems.

I. Division 27: Communications.

J. Division 28 05 00: Common Work for Electric Safety and Security.

K. Division 28 46 00: Fire Alarm and Detection System.

L. Division 28 16 00 Security Detection and Alarm Systems

1.4 DEFINITIONS

A. ACS: Access Control System

B. CCTV: Closed Circuit Television

C. LAN: Local Area Network

D. WAN: Wide Area Network

E. EC: Electrical Contractor

F. SC: Electronic Security Systems Contractor

G. CAD: Card Access Door

1.5 SUBMITTALS

A. Reference Division 01 – Submittal Procedures

1. Shop Drawings: Provide shop drawings of system wiring diagrams showing all equipment, device placement, and wiring connection required. Drawings to include one-line riser diagrams, device ID numbers and zone schedules, operational matrix, and location of all end-of –line (EOL) devices. Each security device shall include device ID number.
2. Product Data: Provide manufacturer's data sheets showing product appearance, electrical characteristics, and connection requirements.
3. Load Calculations: Provide load calculations for all system power supplies, and battery standby systems.
4. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use, as stipulated by the product-testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and start-up or products.
5. Exceptions: Provide a detailed listing of any and all exceptions, variances, and non-conformances to the specifications and contract design drawings. Failure to disclose any such items shall be grounds for immediate disapproval of submittals without comment.
6. Samples: Provide samples of various items.
    a. Provide a minimum of two (2) samples of all security cable to be installed on the projects. Cable samples shall be of sufficient length to identify cable marking (striping) and cable listing identification.

b. Provide a minimum of two (2) samples of all cable supporting devices, metal bridle rings, metal mounting brackets, plastic plenum rated wire brushings, and other applicable cable installation equipment to be utilized on the project.

7. Card Access/Security System Installer: Documented experience and certifications of Installation Supervisor.

1.6 CLOSEOUT SUBMITTALS

A. Reference Division 01 – Closeout Procedures.

B. Record Drawings

1. Record "As-Built" locations of all system components, card readers, security devices, and end-of-line devices. Include "as-built" conduit and wire counts.
2. As-Built Drawings shall consist of one (1) full size bond hard copy set, one half-size bond hard copy set, and one electronic AutoCAD© DWG copy on CD format of all sheets.

C. Operation and Maintenance (O&M) Manuals:

1. Operation Data: Provide operating instructions, detailed for the specific project.
2. Maintenance Data: Provide maintenance and repair procedures for each type of equipment provided, as applicable. Include any specific requirements particular to the project.
3. Equipment Data: Provide manufacturer data sheets or catalog sheets for each type of equipment provided.
4. Spare Parts Data: Provide manufacture's recommended spare parts list, including quantity, and any equipment replacement schedules, as applicable.
5. Supplier Data: Provide system manufacturer and local service organization information. Include contact, phone numbers, and addresses, as applicable.
6. Warranty Data: Provide system warranty information, including all material and /or labor items.

D. Warranty:

1. The manufacturer shall guarantee the system equipment for a minimum period of one (1) year from the date of final acceptance of the system. Any additional warranty periods shall be listed in the Operation and Maintenance Data Manuals. Any defective equipment, material, or software shall be replaced as no cost to the Owner during this warranty period.
2. The Installing Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for a minimum period of one (1) year from the date of final acceptance of the system. Any defective material and-or labor shall be replaced at no cost to the Owner.

E. Maintenance Service:

1. Furnish warranty service of the card access system for one (1) year from the date of final acceptance of the system, as follows:
   a. Basic Services: Systematic visits, as required; at times coordinated with the owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

F. Provide extra materials, as follows:

1. Provide 5% of the total device count each type of detector minimum 1.
2. Provide 5% of the total device count each type of door switch minimum 1.
3. Provide 5% of the total device count each type of card reader minimum 1.
4. Provide 5% of the total device count each type of request-to-exit (RX) motion detector minimum 1.
5. Provide six (6) of each type of key.
6. Provide two (2) hard copies of all system programming (points list) software.
7. Provide two (2) electronic copies of all system programming (software); flash drive format.
8. Provide Contractor red-line construction drawing set, with mark-ups.
9. Provide one (1) full size bond hard copy set of As-Built record drawing set.
10. Provide one (1) half size bond hard copy set of As-Built record drawing set.
11. Provide one (1) electronic copy of As-Built record drawing sets; in AutoCAD dwg file format on CD format.
12. Provide any special test equipment, filters, test leads, cords, etc. required to test the system.

1.7 QUALITY ASSURANCE

A. All equipment shall equal or exceed the minimum requirements of NEMA, ASME, ANSI and Underwriter's Laboratories. An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. All material ad equipment furnished shall be new and unused and free from defects. Equipment shall be clean and free of damage or corrosion, and shall be of the best quality obtainable foe the purpose intended.

C. Where more than one of any specified item if equipment of material is required, such as items shall be the product of one manufacturer throughout the facility.

D. All materials used shall bear labels attesting to Underwriter's Laboratory or other Nationally Recognized Testing Laboratory (NRTL) approval, provided a standard is established for the material in question.

E. All materials shall conform strictly to the standards and specifications set forth in this document. Unless otherwise specified, all products furnished shall be designed, built and installed in accordance with the latest and best practice of the electrical industry, and shall conform to the standards of the NEMA, ANSI, TIA / EIA, IEEE, and NEC, and this Specification wherever they apply.

F. Contractor personnel shall be qualified to perform the work and be knowledgeable on the following standards, skills, and activities, as applicable:

1. TIA / EIA 568B, 569B, 606A, and 607A Standards.
2. Testing conductors for electrical continuity.
3. Testing copper and fiber circuits for performance compliance.
4. Bonding and grounding where required.
5. Cable terminations for specified connectors and terminations for copper and fiber cable.

G. Contractor personnel will be required to provide and use the proper tools in the performance of each activity. The tools must be in good working order. The Owner reserves the right to review the tool lists and tool maintenance procedures of the Contractor.

H. Access Control / Security System Contractor may sub-contract the access control panels and device terminations.

1.8 QUALIFICATIONS

A. Manufacturer: Limited to specific equipment as approved by the District.

B. Project Engineer: Company shall employ an Engineer of Record with a registered P.E. in security system design, or a registered P.E. in a related engineering discipline, with a minimum of two (2) years' experience in security system design, or a minimum of five (5) years of documented experience in security system design.

C. Installer: The Installing Company and personnel assigned to the project must specialize in installing the products specified in this section and shall meet, at a minimum, the following:
   1. Installer shall be licensed by "City and County of Denver" as Access Control System Supervisor. Minimum experience required as follows:
      a. Three (3) years' experience working in the access control trade with similar type projects..
      b. Experience must be displayed in each of the following disciplines:
         i. Electrical Design and Installation
         ii. Hardware Application and Installation (e.g., maglocks, card readers, electric locks and strikes)
   2. Final programming of Card Access/Security System shall be performed by the Owner.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instruction.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

PART 2 - PRODUCTS

2.1 MANUFACURERS

A. Subject to compliance with specified requirements, products of the following manufacturers shall be acceptable:

   1. Base Bid: The Base Bid shall be based upon IDenticard Systems, Inc. "PremiSys System"
   2. Substitutions: No Substitutions allowed.

2.2 EQUIPMENT AND DEVICES

A. ACCESS CONTROL ENTERPRISE APPLICATIONS (Existing)

1. The system shall use a virtual server that communicates with client computers and field hardware. The system shall be of true multiuser design and capable of simultaneous operations from multiple client interfaces. A user logged onto any one client interface shall not affect the system control by users logged onto other client interfaces.
2. The System Server, is centrally located at the District's Central Data Center in the Educational Services Building in Denver West. The Server is connected to the District's WAN for communication to all access control devices located throughout the District. Server updates are done separately and are not in this contract.
3. Access control panels located in the school MDF rooms shall communicate with the Server database, as shall the remote workstations located in the school.
4. The access control system shall be a versatile, user friendly, enterprise type system, which both controls / monitors facility access as well as manages facility security parameters.
5. The access control system shall utilize an Ethernet topology, for communications over the District's LAN / WAN.
6. The access control system shall be capable of interfacing with additional facility systems such as security surveillance system and fire alarm.
    a. System shall be capable of arming and disarming the Vista security surveillance system using event function. (2 separate relay functions)
    b. System shall disarm designated Vista security partitions on Access Granted into the associated partitioned zone.
    c. The system shall be capable of a master arm and disarm of the Vista security surveillance system from the Card Access Control System.
    d. The system shall monitor the Vista Security arm status of each partition using a monitoring point in the Card Access System.
    e. The system shall be capable of broadcasting the system status over the school paging system. Refer to Division 28 16 00 2.1.A.15
        I. Utilizing 2 each ELK-124 Voice Modules:
            a. Module 1:
                i. Message 1: Security System Arming Warning from Vista Panel
                ii. Message 2: Security System Intrusion Alarm from the Vista Panel
            b. Module 2:
                i. Message 1: Lockdown from the PremiSys system
                ii. Message 2: Building Secure from the PremiSys system
                iii. Message 3: Building Secure Clear from the PremiSys system

7. Equipment and Software shall be IDenticard, and shall utilize the PremiSys software platform.

B. ACCESS CONROL SYSTEM MANAGEMENT

1. The software shall support a maximum of 254 channels per system and a maximum of 8 controllers per channel.
2. The system hardware shall support various communication methods for communication among host computers, controllers and I/O components. It shall be possible to use serial RS-232 or serial RS-485 methods as well as TCP/IP over Ethernet methods, with dependence on the communications specifications of the individual controllers. Communications among controllers and I/O boards in the system shall be via serial RS-

485.

3. It shall be possible for system users to define the number of times the host attempts to retry to connect to a controller before the controller is considered offline by the system. The range of times shall be 0-32,767.
4. System integrators shall be able to enable or disable communication to individual I/O boards and select the speed to communication between each. The baud rate of communications among the controllers and I/O boards shall be user-selectable from among the following: 2400; 9600; 19,200; 38,400 and 115,200.
5. The database software shall allow any system transaction or event to globally link to, and actuate, any relay or relay group, device driver, WAV files, bitmap, alarm group, or any combination of these anywhere in the system. Links assigned to specific cards are viewable on a card-by-card basis.
6. Downloading: System administrators or other authorized users shall be capable of downloading any selected or all system setup parameters and databases to any selected or all system controllers. The system software shall indicate when any download is complete.
7. System Security and User Rights: For each application-level user of the system, it shall be possible for the administrator to define the user name, enter the full first and last names of the user, define a password, and enter an e-mail address. It shall also be possible to establish activation and expiration dates for the user account in the system. Passwords permissible for use in the software shall conform to default Windows® requirements. It shall also be possible for the administrator to use the network user names and passwords of LDAP users.
8. User Interface: The User Interface shall incorporate a menu bar with drop-down menus and display icons for full system setup and operation. This menu and these icons shall offer to system users complete access on one screen to all system functions and system setup parameters to which the users have rights. Users shall be able to design, store and display multiple, individually created screens used to display cardholder information and data. The system shall support an unlimited number of operator defined screen layouts that shall accommodate the data fields in the system. The system shall additionally be built and delivered with a standard, ready-to-use data-entry screen. This product standard screen shall be modifiable by the operator and saved under a new screen name.
9. General Software, GMT & Time: It shall be possible to retrieve the system time of a host and store it within the controller. Users shall be able to assign local and daylight saving time offsets from GMT for use within the system. For transaction logging, the controller shall use the host's system time, which has been synchronized with the GMT. The controller shall use this local time, with an optional daylight savings offset, for schedules and time zones.
11. Access Levels & Groups: It shall be possible to establish up to 32 access levels per cardholder that designate the permissible readers that cardholders may use and the time zones, or schedules, during which they may be used. By defining the permissible readers, the areas to which each cardholder has access rights shall thereby be defined. This definition of access rights in the system shall allow access to any cardholder if a particular time zone is active at a particular reader, that reader is part of the access level, and all other access-rights tests prove valid for that cardholder.
12. Card Formats: Users shall be able to select ABA and Wiegand reader and card formats. Up to eight card formats shall be selectable per reader. These card data formatting capabilities shall allow the use of different reader technologies without modification to the software. This system shall utilize proximity readers.
13. Alarm Acknowledgements: The software shall provide for alarm management capabilities. It shall be possible to set up any system transaction or event to require alarm acknowledgement. The system shall provide user-defined alarm-handling capabilities to include easy-to-use interfaces to create alarm acknowledgement alert

messages, acknowledgment response options and priority parameters, and password and comment requirements. Alarm management shall also provide for disabling alarm acknowledgement on the system.

14. Triggers and Procedures: The software shall provide customizable means by which users can choose an event in the system to trigger an action that the system takes in response to the event or to be associated with the event. These triggers and procedures shall provide a means for event-based control as opposed to solely time-based control, although the starting and ending of time zones can be used as triggers. It shall be possible to choose any system transaction as a trigger. It shall be equally possible, through the use of user levels as described in this specification, to use any card-generated transaction, any action or any system event as a trigger.
15. Card Access doors (CAD) will be provided as follows
    a. Read In systems will be provided based on the operations need of the site to manage student flow.
    b. Entry closest to temporary buildings housing students
    c. At each floor level of an elevator
    d. Kitchen deliveries
    e. Playgrounds
    f. Read In\Read Out systems will be installed at established AFTER HOURS entries only.
    g. Read In at the inside vestibule door

C. ACCESS CONTROL SYSTEM INFRASTRUCTURE

1. Access Control System Wire and Cable as specified in Section 28 05 00.

D. ACCESS CONTROL SYSTEM REMOTE DEVICES

1. Client Workstation (existing PC)
    a. Shall be furnished by the District.
2. 2 Door with Controller Panel: (Basic system includes 1 two door controller + 3 two reader IO boards.
    a. Shall be a programmable smart panel, which controls all access control equipment locally within a school.
    b. Shall be capable of controlling all card reader doors and connected equipment.
    c. Shall make intelligent access control decisions locally, without requiring verification to the Server.
    d. Shall have on board memory for operation as a stand-alone panel if communications are lost with the server.
    e. Shall be located in the school MDF / IDF rooms, as indicated in the drawings using IDenticard Large enclosure.
    f. Shall be PremiSys Panel.
    g. All IDenticard boards shall be housed in a powder-coated heavy-gauge steel enclosure provided by IDenticard with a hinged front door, cam lock and tamper switch.
    g. Shall be provided with a 8-hour – 5-minute battery standby system.
3. Network Card
    a. The network card shall allow communication between a system Server and a controller to be conducted over an Ethernet network.
    b. The network card shall be assigned an IP address and shall be programmed using a software application separate from the access-control system software. All necessary settings in the card shall be configurable using only this software, and

no hardware settings made via jumpers, DIP switches and the like shall be necessary.

c. The network card shall incorporate a RJ-45 (10Base-T) Ethernet connector for the host-controller communications as well as indicator lights to verify card function and to permit card diagnostics.

4. Two Reader IO Board: (Basic system will include 3 two door IO cards)
   a. The two-reader board shall be connected to a system controller and act as an interface between this controller and any of a variety of readers that can read ABA-formatted data or Wiegand®-formatted data from proximity cards. The board shall also be capable of supporting tri-stated LED control and buzzer control.
   b. The two-reader board shall support up to two (2) reading devices of the same or different technologies, the type being selectable through the application software. Systems that are unable to use readers of different technologies on the same board or require a change in software, firmware or "other" interface devices shall be unacceptable.
   c. The two-reader board shall use quick-disconnect terminal blocks for all interconnections to the interface. The two-reader board shall be intended for use in low voltage, Class 2 circuits only.
   d. The two-reader board shall communicate to a controller via a two-wire RS-485 interface, which shall allow multi-drop communication on a single bus of up to 4,000 feet (1,200 m). It shall be possible to connect up to 64 I/O boards, some of which can be two-reader boards, to a single expandable controller described in the specification, or up to 32 I/O boards, all or some of which can be two-reader boards, to a single compact controller described in the specification. All communications lines shall be supervised in the system, and transactions shall be provided in the system to alert the operator of offline or disconnect statuses. Provision to set end-of-line (EOL) resistance for the board itself shall be built into the board should this resistance be needed.
   e. Each two-reader board shall be uniquely addressable by the user through the settings of a dual in-line package (DIP) switch on the board. In addition, this DIP switch shall be used to select the baud rate of communication with the controller.
   f. All input boards shall be housed in a powder-coated heavy-gauge steel enclosure with a hinged front door. Five (5) conduit knockouts shall be available on two sides of the enclosure and on its back.
   g. The two-reader board shall provide sensor monitoring via its eight (8) supervised inputs, which can be used as door-position inputs, request-to-exit inputs and for other purposes. The states of the inputs shall be as follows: normally open; normally closed; 1 K normal, 2 K active; and 2 K normal, 1 K active. It additionally shall be possible to set the debounce and hold times for each input on the board. It shall be possible to set all input configuration via the system software.
   h. It shall be possible via the system software to link any input or relay on the two-reader board to cause an action on any other relay on the same board or on any other system boards and to select the action that the linked relay will take when the triggering input or relay is activated. The inputs shall be configurable to use or not to use end-of- line (EOL) resistors for normally open or normally closed contacts.
   i. The two-reader board shall also provide six Form-C, noninductive contact relays with ratings of 5 A at 28 VDC for optional use in controlling door locks, alarm signals or other devices. Control of the relays shall be software-assignable to be triggered by a reading device, cardholder, time zone and/or other system actions. The relays shall be configurable for normal (relay energized when “on”) or inverted (relay de-energized when “on”) action. Pulse time of a relay used as a door-lock relay shall be software-selectable between 1 and 255 seconds.

5. Remote Input Board

a. The input board shall be connected to a system controller and provide sensor monitoring and output control via its 16 supervised inputs. The states of the inputs shall be as follows: normally open; normally closed; 1 K normal, 2 K active; and 2 K normal, 1 K active. It additionally shall be possible to set the debounce and hold times for each input on the board. Each input point shall have a corresponding LED on the board that indicates the state of the point.
b. The input board shall also provide two Form-C contact relays for optional use in controlling door strikes or other devices. Control of the relays shall be software-assignable to be triggered by system actions. Pulse time of the relays shall be software-selectable between 1 and 255 seconds, inclusive.
c. It shall be possible via the system software to link any input or relay on the input board to cause an action on any other relay on the same board or on any other system boards and to select the action that the linked relay will take when the triggering input or relay is activated.
d. All interconnections to the interface shall be via quick-disconnect terminal blocks. The input board shall be intended for use in low voltage, Class 2 circuits only.
e. The input board shall communicate to a controller via a two-wire RS-485 interface, which shall allow multi-drop communication on a single bus of up to 4,000 feet (1,200 m). It shall be possible to connect up to 64 I/O boards, all or some of which can be input boards, to a single expandable controller described in the specification, or up to 32 I/O boards, all or some of which can be input boards, to a single compact controller described in the specification. All communications lines shall be supervised in the system, and transactions shall be provided in the system to alert the operator of offline or disconnect statuses. Provision to set end-of-line (EOL) resistance for the inputs 1 through 16 and for the board itself shall be built into the board should this resistance be needed.
f. Each input board shall be uniquely addressable by the user through the settings of a dual in-line package (DIP) switch on the board. In addition, this DIP switch shall be used to select the baud rate of communication with the controller.
g. All input boards shall be housed in a powder-coated heavy-gauge steel enclosure provided by IDenticard with a hinged front door and cam lock. Five (5) conduit knockouts shall be available on two sides of the enclosure and on its back.
h. The input board shall accept 12 to 24 VDC for power.
i. Shall be provided with an 8-hour - 5-minute battery standby system.

6. Remote Output Board:
a. The output board shall be connected to a system controller and provide output control via 16 Form-C, noninductive relays with ratings of 5 A at 28 VDC. The relays shall be configurable for normal (relay energized when “on”) or inverted (relay de-energized when “on”) action. It shall also be possible to define the response desired for each relay when communications are lost between the output board and the controller: The relay shall be active, the relay shall be inactive, or the relay shall maintain its status at the moment communications are lost. Each relay shall have a corresponding LED on the board that indicates when the relay is energized.
b. Control of the relays shall be software-assignable to be triggered by a reading device, cardholder, time zone and/or other system actions. Pulse time of the relays shall be software-selectable between 1 and 255 seconds, inclusive.
c. It shall be possible via the system software to link any relay on the output board to cause an action on any other relay on the same board or on any other system boards and to select the action that the linked relay will take when the triggering relay is activated.
d. All interconnections to the output board shall be via quick-disconnect terminal blocks. The output board shall be intended for use in low voltage, Class 2 circuits only.

e. The output board shall communicate to a controller via a two-wire RS-485 interface, which shall allow multi-drop communication on a single bus of up to 4,000 feet (1,200 m). It shall be possible to connect up to 64 I/O boards, all or some of which can be output boards, to a single expandable controller described in the specification, or up to 32 I/O boards, all or some of which can be output boards, to a single compact controller described in the specification. All communications lines shall be supervised in the system, and transactions shall be provided in the system to alert the operator of offline or disconnect statuses. Provision to set end-of-line (EOL) resistance for the board itself shall be built into the board should this resistance be needed.
f. Each output board shall be uniquely addressable by the user through the settings of a dual in-line package (DIP) switch on the board. In addition, this DIP switch shall be used to select the baud rate of communication with the controller.
g. All output boards shall be housed in a powder-coated heavy-gauge steel enclosure with a hinged front door. Five (5) conduit knockouts shall be available on two sides of the enclosure and on its back.
h. The output board shall accept 12 to 24 VDC for power.
i. Shall be provided with a 4-hour - 5-minute battery standby system.

7. Power Supply:
   a. Auxiliary power supply shall be installed in conjunction with the door control panel(s), to provide dedicated low voltage power for the electronic door locks and other peripheral devices such as motion detectors.
   b. Shall be voltage selectable for either 12 or 24 VDC and shall be minimum 6 Amp output.
   c. Shall be a separate power supply, set to 24vDC, for the electronic door hardware.
   d. Shall be a separate power supply, set to 24vDC, for the ACS electronic devices.
   e. Shall be installed such that there is a minimum 25 % spare load capacity under worst case operating conditions.
   f. Shall be located at panel locations, as indicated on the drawings.
   g. Shall be provided with an 8-hour – 5-minute battery standby system.
   h. Shall be manufactured by Altronix, or District approved equal.
   i. Shall be monitored by the ACS for AC fail and low battery.
8. Card Reader:
   a. Shall be proximity type, Weigand format card reader.
   b. Shall communicate with the local door control panel.
   c. Shall have operating range of 4-inches.
   d. Shall be installed at 48-inches to center AFF.
   e. Shall be the proper model and type, to function correctly with the specific door and back box.
   f. Shall be a manufactured by AWID, or District approved equal.
9. Door Lock:
   a. Shall be 24vDC low voltage electronic door lock or strike.
   b. Shall be wired to the local door control panel.
   c. Shall be provided and installed by the Division 8 Door hardware Supplier.
   d. Shall be surface mounted fail secure electric strike, electrified panic bar w/hex key dogging or electrified lockset with classroom function with keyed cylinders on both sides.
   e. Shall be manufactured by HES, or District approved equal depending a specific door hardware used.
   f. Removable mullions will be provided with a Molex connector at the top of the mullion to allow easier removal of the mullion. Use armored cable to 2 feet above and 2 feet below the molex connector to protect the strike wire.
   f. Coordinate installation with the GC, EC and SC.
10. Request-to-Exit Motion Detector:

a. All card reader doors shall be equipped with request to exit motion detectors.
b. Shall be Bosh DS160 in black or white depending on door finishes, or District approved equal.
c. REX shall be located directly above the door header or ceiling looking back into the space as high as possible within manufactures range requirements.
d. Provide enough REX devices at the CAD entry to cover all doors at the entry.

11. Door Position Switch:
    a. All exterior doors at the access control reader entry / egress locations shall be equipped with position switches.
    b. Shall be mounted no less than 6-inches from the door latch.
    c. For in-jamb applications, the door position switch shall be Sentrol 1078-W wide gap for steel doors, or District approved equal. Magnets in door channel top shall be properly secured in place to avoid shifting.
    d. For surface mount applications, the door position switch shall be Sentrol 2505A wide gap type with armored cable, or District approved equal.
12. Security Key Pad:
    a. Provide remote security keypad where indicated on the drawings. Refer to Division 281600 2.1.6.d
    b. Shall contain integral alphanumeric keypad with symbols arranged in ascending ASCII code ordinal sequence.
    d. Shall be Vista 6160.
13. Proximity Cards: (provided by District)
    a. Shall be proximity type, weigand format, fully compatible with the local door control panel.
    b. Shall be furnished by the District.
14. Wireless Transmitter / Receiver: for Lockdown\Lockout buttons
    a. Shall be Inovonics 902-928 MHz EchoStream .
    b. Transmitter shall be single channel, EN1210, or District approved equal.
    c. Receiver shall be four zone EN4216 with 4 relays, or District approved equal.
    d. Contractor shall field locate the wireless receiver, such that proper reception of the wireless transmitter signal is achieved and the LEDs are visible from floor level and never hidden above ceilings or equipment.
15. Protective Device Wire Guards:
    a. Shall be provided in any area where damage is likely to occur. They are required in Gyms, Locker and Weight rooms
    b. Device wire guards shall be UL Listed for the specific device and installation application.

E. SECURITY LOCKDOWN\LOCKOUT BUTTONS:

1. Shall be a latching push-button type. Each site will receive both switches at the listed locations below.
2. One button shall be hardwire type in the MDF Room, mounted at 48-inch AFF to the center of the box.
3. One LOCKDOWN button shall be wall mounted in the Main Office and shall be STI SS2071LD-EN with an Inovonics transmitter.
4. One SECURE PERIMETER button shall be wall mounted in the Main Office and shall be STI SS2471ZA-EN with an Inovonics transmitter. (custom message Line 1: “SECURE”, Line 2: “PERIMETER”)

F. SECURITY, CARD ACCESS INTERFACE RELAY BOARD

1. Vista Relay Module #4204: For interface of voice annunciation to paging system through

access control system and Vista Security. Refer to Division 281600 for operation.

G. VOICE ANNUCIATOR

1. 2 each Elk 124-V2 eight channel voice record/playback Annunciator, capable of recording and playing back eight different messages. Each message shall be able to be up to 90 seconds long. The unit shall have an integrated microphone, record pushbutton, and playback volume control.
   I. Module 1:
      a. Message 1: Security System Arming Warning from Vista Panel
      b. Message 2: Security System Intrusion Alarm from the Vista Panel
   II. Module 2:
      a. Message 1: Lockdown from the PremiSys system
      b. Message 2: Building Secure from the PremiSys system
      c. Message 3: Building Secure Clear from the PremiSys system

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install wiring in plenum rated cable. Cable routing shall be perpendicular to or parallel to structural building members, and shall utilize a metal bridal ring type support system attached to structural building members only. Mounting cable to other building systems (fires protection, electrical conduit, mechanical ductwork, etc.), or running cable in any fashion other than described, is strictly forbidden. See Section 3.02 for additional open cable requirements.

C. Mount end-of-line device in box with last device.

D. Make conduit and wiring connections to door strike devices and other applicable devices, furnished under other Sections.

E. Label each device as specified in 28 05 00.

F. All device drops will be provided with a 10 foot service loop located directly above the device on the last bridal ring of the wire run.

G. All panels will have panduit between each panel and to a height of 7 feet. Refer to DCAD and MDF\IDF layout for details on enclosure placement and spacing.

H. All exposed cabling will be routed through panduit, conduit or plastic Wiremold©, and shall be secured with a minimum of 1 strap or screw attachment per segment and every 2 feet. Provide manufactures joint, corner, caps and finish pieces as needed to make a complete cable path. Glue all joint, corners, caps and finish pieces in place using RTV.

H. No penetrations shall be made on the bottom of any enclosure. This space shall be used for batteries. All enclosure penetrations will have bushings with strain relief. Do not use romex connectors.

3.2 OPEN (Plenum) CABLE INSTALLATION REQUIREMENTS

A. Open cabling shall be installed as specified in Section 28 05 00.

3.3 FIELD QUALITY CONTROL

A. Test in accordance with manufacturer's recommended testing practices.

B. Provide forty-eight (48) hours' notice to the Engineer and District personnel for rough inspection, prior to installing ceiling tiles or drywall.

C. Provide seven (7) day prior notice to the Engineer and District personnel for scheduled contractor pre-testing of the system.

D. Provide three (3) day prior notice to the Engineer and District personnel for the scheduled final commissioning Owner testing of the system.

E. Provide two (2) detailed records of the pre-testing of the system. One copy for the District and one for the facility's System logbook. Pre-testing record must contain a minimum of the device ID, proper functionality of the device (door unlock, card read, etc.), and date of the testing. Submit suggested Contractor testing form for approval by the District in advance of the system pre-test.

F. Provide a Security Device Location Map in AutoCAD© dwg file format and a hard copy PDF print. Map must include the site plan, floor plan with room #s, true device locations and field labels of all Cameras, CAD and Motion detection devices only.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

B. Include services of a Factory-certified technician to supervise installation, adjustments, final connections, and system testing.

C. Provide two (2) hard copies and two (2) electronic copies in CD ROM or flash drive format of the final system programming and Security Device Location Map. One set to be delivered to the District Project Manager for the District Central Reporting System programming, and one set to be left inside the facility's card access panel back box.

3.5 DEMONSTRATION

A. Demonstrate normal and abnormal modes of operation, and required responses to each.

3.6 TRAINING

A. Provide the services of a factory-certified service representative to demonstrate the system and train Owner's maintenance personnel as specified below:

1. On-Site Training: Provide a minimum of two (2) hours of on-site training of the facility's school staffing in the basic operations and functionality of the access control / security system panel, and field devices. Review field panel locations, typically device locations, and 120vAC power locations (panels, breakers, and circuits). Demonstrate the various system responses to the field off-normal conditions. Simulate card access conditions,

supervisory conditions, security conditions, trouble conditions, and ground fault conditions of the various field devices. Provide written instructions of basic system operating instructions in the Card Access System Logbook, located adjacent to the access control-panel.

B. On-Site System Training shall be completed within six (6) days of completion of the system and final system commissioning test. Off-Site System Training shall be completed within thirty (30) days of completion of the system, unless the District specifically directs an alternate training schedule.

C. Schedule On-Site Training with the District at least three (3) days in advance. Schedule Off-Site Training with the District at least fourteen (14) days in advance.

END OF SECTION

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SECTION 28 16 00
SECURITY DETECTION AND ALARM SYSTEMS

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the Contract Documents, including the General and Supplementary General Conditions, and Division 1 – General Requirements shall apply to work of this Section.

1.2 SCOPE

A. Scope of Work for the Electronic Security Contractor (SC) shall consist of furnishing all labor, equipment, wiring, supplies, materials, and programming, unless otherwise specified, necessary for the installation of a complete Security Surveillance System (SSS) as required by the specifications and as shown on the drawings, subject to the terms and conditions of the contract. The Work shall also include the completion of those details of work not mentioned or shown which are necessary for the successful operation of the SSS System.

B. The SSS System shall consist of, but it not limited to, the following types of equipment.

1. Control Panel
2. Keypads
3. Relay Modules
4. Voice Recording Modules
5. Access Control Interfaces
6. Motion detectors
7. Door Contacts
8. Monitor inputs SIMS
9. 7847i-ENT Enterprise Intranet Communicator

1.3 RELATED SECTIONS

A. Division 07: Fire and Smoke Protection
B. Division 26: Common Work Results for Electrical Systems.
C. Division 26: Low Voltage Electrical Power Conductors and Cables.
D. Division 26: Grounding and Bonding for Electrical Systems.
E. Division 26: Hangers and Supports for Electrical Systems.
F. Division 26: Raceways and Boxes for Electrical Systems.
G. Division 26: Identification for Electrical Systems.
H. Division 27: Communications.
I. Division 28 05 00 Common Work Results for Electronic Life Safety and Security
J. Division 28 13 00: Access Control Security System.
K. Division 28 23 00: Video Surveillance Security Systems.
L. Division 28 46 00: Fire Alarm and Detection System. (New and Existing)
M. Data, Communication and Alarm Diagram (DCAD)

1.4 REFERENCES

A. Underwriters Laboratories (UL):

1. UL 365 – Police Station Connected Burglar Alarm Units and Systems
2. UL 609 – Local Burglar Alarm Units and Systems

3. UL 611 – Central Station Burglar-Alarm Units
4. UL 985 – Household Fire Warning System Units
5. UL 1023 – Household Burglar-Alarm System Units
6. UL 1076 – Proprietary Burglar Alarm Units and Systems
7. UL 1610 – Central Station Burglar-Alarm Units

B. Federal Communications Commission (FCC):

1. Code of Federal Regulations Title 47 - Part 15 – Radio Frequency Devices.
2. Code of Federal Regulations Title 47 - Part 68 – Connection of Terminal Equipment to the Telephone Network.

C. National Fire Protection Association (NFPA):

1. NFPA70 – National Electrical Code as accepted by state of Colorado

1.5 SYSTEM DESCRIPTION

A. The system shall be a Vista 128BP Burglary Switching System that includes the following capabilities:

1. Listed for UL Commercial Burglary
2. Supports up to 128 zones.
3. Supports up to eight (8) separate partitions.
4. Supports up to 150 users.
5. Provides integrated security, access control, and CCTV switching capability.
6. Provides supervision of peripheral devices.
7. Supports up to 96 optional relay outputs.
8. Supports long-range radio (LRR) communication.
9. Provides scheduling capability to allow for automated operations.
10. Supports up to eight (8) alphanumeric paging devices.
11. Supports panel linking.
12. Supports alarm reporting via Internet.
13. Interfaces with automation software.
14. System shall interface with Building Card Access System.

1.6 SUBMITTALS

A. Reference Division 01 – Submittal Procedures

1. Shop Drawings: Provide shop drawings of system wiring diagrams showing all equipment, device placement, and wiring connection required. Drawings to include one-line riser diagrams, device ID numbers and zone schedules, operational matrix, and location of all end-of –line (EOL) devices. Each security device shall include device CID zone number as it reports to Jeffco Alarm Center.
2. Product Data: Provide manufacturer’s data sheets showing product appearance, electrical characteristics, and connection requirements.
3. Load Calculations: Provide load calculations for all system power supplies, and battery standby systems.
4. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use, as stipulated by the product-testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and start-up or products.
5. Exceptions: Provide a details listing of any and all exceptions, variances, and non-

conformances to the specifications and contract design drawings. Failure to disclose any such items shall be grounds for immediate disapproval of submittals without comment.

6. Samples: Provide samples of the following items.
   a. Provide a minimum of two (2) samples of all security cable to be installed on the projects. Cable samples shall be of sufficient length to identify cable marking (striping) and cable listing identification.
   b. Provide a minimum of two (2) samples of all cable supporting devices, metal bridle rings, metal mounting brackets, plastic plenum rated wire brushings, and other applicable cable installation equipment to be utilized on the project.
   c. Provide a minimum of one of each type of motion detector, hard wired and wireless lockdown button, wireless interface receiver, SIM module etc.
7. Card Access/Security System Installer: Documented experience and certifications of Installation Supervisor.

1.7 CLOSEOUT SUBMITTALS

A. Reference Division 01 – Closeout Procedures.

B. Record Drawings

1. Record “As-Built” locations of all system components, card readers, security devices, and end-of-line devices. Include “as-built” conduit and wire counts.
2. As-Built Drawings shall consist of one (1) full size bond hard copy set, one half-size bond hard copy set, and one electronic AutoCAD© DWG copy on CD format of all sheets.

C. Operation and Maintenance (O&M) Manuals:

1. Operation Data” Provide operating instructions, detailed for the specific project.
2. Maintenance Data: Provide maintenance and repair procedures for each type of equipment provided, as applicable. Include any specific requirements particular to the project.
3. Equipment Data: Provide manufacturer data sheets or catalog sheets for each type of equipment provided.
4. Spare Parts Data: Provide manufacture’s recommended spare parts list, including quantity, and any equipment replacement schedules, as applicable.
5. Supplier Data: Provide system manufacturer and local service organization information. Include contact, phone numbers, and addresses, as applicable.
6. Warranty Data: Provide system warranty information, including all material and /or labor items.

D. Warranty:

1. The manufacturer shall guarantee the system equipment for a minimum period of one (1) year from the date of final acceptance of the system. Any additional warranty periods shall be listed in the Operation and Maintenance Data Manuals. Any defective equipment, material, or software shall be replaced as no cost to the Owner during this warranty period.
2. The Installing Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for a minimum period of one (1) year from the date of final acceptance of the system. Any defective material and-or labor shall be replaced at no cost to the Owner.

E. Maintenance Service:

1. Furnish warranty service of the security system for one (1) year from the date of final acceptance of the system, as follows:
    a. Basic Services: Systematic visits, as required; at times coordinated with the owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts and components with original manufacturer's replacement parts, components, and supplies.

F. Provide extra materials, as follows:

1. Provide 5% of the total device count each type of detector minimum 1.
2. Provide 5% of the total device count each type of door switch minimum 1.
3. Provide 5% of the total device count type of Serial Interface Module minimum 1
8. Provide six (6) of each type of key.
9. Provide two (2) hard copies of all system programming (points list) software.
10. Provide two (2) electronic copies of all system programming (software); flash drive format.
11. Provide Contractor red-line construction drawing set, with mark-ups.
12. Provide one (1) full size bond hard copy set of As-Built record drawing set.
13. Provide one (1) half size bond hard copy set of As-Built record drawing set.
14. Provide one (1) electronic copy of As-Built record drawing sets; in AutoCAD© DWG file format on flash drive.
15. Provide any special test equipment, filters, test leads, cords, etc. required to test the system.

1.8 QUALITY ASSURANCE

A. All equipment shall equal or exceed the minimum requirements of NEMA, ASME, ANSI and Underwriter's Laboratories. An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. All material ad equipment furnished shall be new and unused and free from defects. Equipment shall be clean and free of damage or corrosion, and shall be of the best quality obtainable foe the purpose intended.

C. Where more than one of any specified item if equipment of material is required, such as items shall be the product of one manufacturer throughout the facility.

D. All materials used shall bear labels attesting to Underwriter's Laboratory approval, provided a standard is established for the material in question.

E. All materials shall conform strictly to the standards and specifications set forth in this document. Unless otherwise specified, all products furnished shall be designed, built and installed in accordance with the latest and best practice of the electrical industry, and shall conform to the standards of the NEMA, ANSI, TIA / EIA, IEEE, and NEC, and this Specification wherever they apply.

F. Contractor personnel shall be qualified to perform the work and be knowledgeable on the following standards, skills, and activities, as applicable:

1. TIA / EIA 568B, 569B, 606A, and 607A Standards.
2. Testing conductors for electrical continuity.
3. Testing copper and fiber circuits for performance compliance.
4. Bonding and grounding where required.

5. Cable terminations for specified connectors and terminations for copper and fiber cable.

G. Contractor personnel will be required to provide and use the proper tools in the performance of each activity. The tools must be in good working order. The Owner reserves the right to review the tool lists and tool maintenance procedures of the Contractor.

1.9 QUALIFICATIONS

A. Manufacturer: Limited to specific equipment as approved by the District.

B. Project Engineer: Company shall employ an Engineer of Record with a registered P.E. in security system design, or a registered P.E. in a related engineering discipline, with a minimum of two (2) years' experience in security system design, or a minimum of five (5) years of documented experience in security system design.

C. Installer: The Installing Company and personnel assigned to the project must specialize in installing the products specified in this section and shall meet, at a minimum, the following:

1. Installer shall be licensed by "City and County of Denver" as Access Control Systems Supervisor. Minimum experience required as follows:
    a. Three (3) years' experience working in the access control trade with similar type projects.
    b. Experience must be displayed in each of the following disciplines:
        i. Electrical Design and Installation.
        ii. Hardware Application and Installation (e.g. maglocks, card reader, electric locks and strikes)
2. Final programming of Card Access/Security System shall be performed by the Owner.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Store products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weather-tight enclosures; maintain within temperature and humidity ranges required by manufacturer's instruction.

B. For exterior storage of fabricated products, place on sloped supports above ground. Cover products subject to deterioration with impervious sheet covering; provide ventilation to avoid condensation.

C. Arrange storage to provide access for inspection. Periodically inspect to assure products are undamaged, and are maintained under required conditions.

PART 2 PRODUCTS

2.1 SYSTEM PERFORMANCE

A. Control Panel - The control panel shall be an Vista 128BPT eight (8)-partition, UL commercial burglary control panel that supports up to 128 zones using basic hardwired, polling loop, and wireless zones. It shall also provide supervision of the bell output, RF receivers, and relay modules. In addition, the control shall provide the ability to schedule time-driven events, and allow certain operations to be automated by pressing a single button. The system shall be capable of interfacing with an ECP long range radio (LRR) unit that can send Contact ID

messages, and alphanumeric paging devices. The control shall provide integrated access control and CCTV-switching capability.

1. Basic Hardwired Zones - The control shall provide nine (9) style-B hardwire zones with the following characteristics:
    a. EOLR supervision (optional for zones 2-8): Shall support N.O. or N.C. sensors (EOLR supervision required for UL installations).
    b. Individually assignable to one of eight (8) partitions.
    c. Supports up to 16 two-wire detectors on one selected zone.
    d. Supports four-wire detectors on any zone (power to four-wire detectors must be supervised with an EOL device).
    e. Supports up to 50 two-wire latching detectors on one selected zone.
    f. Standard zones will be as follows. These zones are connected to Card Access Control Relays for interface between the two systems. These zones will be assigned to partition # 8 as a hidden partition.
        I. Zone 1 not used
        II. Zone 2 Master Arm zone. Arms all partitions.
        III. Zone 3 Master Disarm zone. Disarms all Partitions.
        IV. Zone 4 Partition 1 Disarm
        V. Zone 5 Partition 2 Disarm
2. Optional Expansion Zones
    a. Polling Loop Expansion – The control shall support up to 119 additional hardwire zones using a built-in two-wire polling (multiplex) loop interface. The polling loop shall provide power and data to remote point modules, and constantly monitor the status of all zones on the loop. Maximum current draw shall not exceed 128 mA. The polling loop zones shall have the following characteristics:
        I. Interface with RPM (Remote Point Module) devices that provide Class B, Style Y (e.g., 4208U/4208SN) or a combination of Class B, Style Y, and Class A, Style Z (e.g., 4208SNF) zones.
        II. Individually assignable to one of eight (8) partitions.
        III. Supervised by the control panel.
        IV. A 12,000 ft (3658 m) wire run capability without using shielded cable.
        V. Each RPM (Remote Point Module) enclosure shall be tamper protected.
    b. Wireless Expansion – The control shall support up to 127 wireless zones using a 5800 series RF receiver (fewer if using hardwire and/or polling loop zones). Wireless zones shall have the following characteristics:
        I. Supervised by control panel for check-in signals (except certain non-supervised transmitters).
        II. Tamper-protection for supervised zones.
        III. Individually assignable to one of eight (8) partitions.
        IV. Supports wireless devices listed for Commercial Burglary using the 5881ENHC RF Receiver.
3. Partitions – The control shall provide the ability to operate eight (8) separate areas, each functioning as if it had its own control. Partitioning features shall include:
    a. A Common Lobby partition (1-8), which can be programmed to perform the following functions:
        I. Arms automatically when the last partition that shares the common lobby is armed.
        II. Disarms when the first partition that shares the common lobby is disarmed.
    b. A Master partition (9), used strictly to assign keypads for the purpose of viewing the status of all eight (8) partitions at the same time (master keypads).
    c. Assignable by zone.
    d. Assignable by keypad.

e. Assignable by relay to one or all eight (8) partitions.
f. Ability to display fire and/or burglary and panic and/or trouble conditions at all other partitions' keypads (selectable option).
g. Certain system options selectable by partition, such as entry/exit delay and subscriber account number.
h. District uses 2 basic partitions for each site. (Partition Control comes from Aux relays on the District Access
    I. Partition 1 is a general area partition and is auto disarmed using access granted from any card reader other than a dedicated Kitchen entry.
    II. Partition 2 is a high security partition and will be disarmed only by keypad operation.
        a. Main Office
        b. Principal Office
        c. Financial Office
        d. Communication closets
        e. Computer labs
        f. Library
        g. Any other area not accessible during after-hours events

4. User Codes – The control shall accommodate 150 user codes, all of which can operate any or all partitions. Certain characteristics must be assignable to each user code, as follows:
    a. Authority level (Master, Manager, or several other Operator levels). Each User Code (other than the installer code) shall be capable of being assigned the same or a different level of authority for each partition that it will operate.
    b. Opening/Closing central station reporting option.
    c. Specific partitions that the code can operate.
    d. Global arming capability (ability to arm all partitions the code has access to in one command).
    e. Use of an RF (button) to arm and disarm the system (RF key must first be enrolled into the system).
5. Peripheral Devices – The control shall support up to 30 addressable ECP devices, which can be any combination of keypads, RF receivers, relay modules, annunciator modules, and interactive phone modules. Peripheral devices have the following characteristics:
    a. Each device set to an individual address according to the device's instructions.
    b. Each device enabled in system programming.
    c. Each device's address shall be made obviously visible (via a programming option).
6. Keypad/Annunciator shall be 6160 Alpha Display – The control shall accommodate up to 16 keypads or six (6) touch-screen (i.e., advanced user interface) keypads. The keypads shall be capable of the following: (leave all stickers and button tags in Vista Enclosure)
    a. Performing all system arming functions.
    b. Being assigned to any partition.
    c. Providing four programmable single-button function keys, that can be used for:
        (1) Panic Functions –activated by wired and wireless keypads; reported separately by partition.
        (2) Keypad Macros –32 keypad macro commands per system (each macro is a series of keypad commands); assignable to the A, B, C, and D keys by partition.
    d. Keypads will be located at each of the following locations.
        I. Each entry with a read out card reader. Co-located directly above the out reader. Power to the keypad will be switched on only when a valid card is presented to the out reader. Keypad power will stay on for 2 minutes.
        II. Facilities Manager power will be always on.
        III. Main Office, power will be always on.

7. Optional Output Relays - A total of 96 relay outputs shall be accommodated using relay modules. Each relay module shall provide four (4) Form C (normally open and normally closed) relays for general-purpose use or two (2) Class-B, Style-Y supervised notification appliance circuit outputs, when using the 4204CF module. The relays shall be capable of being:
    a. Programmed to activate in response to system events.
    b. Programmed to activate using time intervals.
    c. Activated manually.
    d. Assigned an alpha descriptor.
    e. Used for Class B, Style-Y supervised bell outputs (4204CF module).
    f. A combination of 4204 (ECP) and 4101SN (polling loop) relays.
    g. Each system will have at least one Vista Relay Module #4204 relay module installed.
        I. Relay #1 will follow Partition 1 Arm status. This point will be monitored by the Access Control System
        II. Relay #2 will follow Partition 2 Arm status. This point will be monitored by the Access Control System.
        III. Relay #3 will pulse for 2 seconds when Partition 1 is armed. This point will be connected to the Elk 124v2 voice module and make a “Security Arming Message”.
        IV. Relay #4 will follow the bell output time. This point will be connected to the Elk 124v2 voice module and make a “Security Alarm Message”. This will retransmit the message each time a security zone is alarmed.
8. Commercial Wireless Equipment – The Control shall be compatible with UL Listed Commercial Wireless Security equipment including:
    a. ADEMCO 5881ENHC Commercial Fire/Burg Receiver. - The receiver shall be capable of receiving as many points as the control panel is rated for. Up to two (2) Receivers may be used on any system. Receivers may be remotely located
    b. ADEMCO 5817CB Wireless Universal Contact Monitoring Transmitter - This device shall be capable of making any conventional UL listed contact device a wireless device. The device shall be UL listed as follows: UL 985 for fire and UL 365, 609, 1023, 1076 and 1610 for security and nurse call.
    c. ADEMCO 5869 Wireless Hold Up Switch/Transmitter - This device shall be UL 636 listed for commercial burglary applications.
9. Voltage Triggers – The system shall provide voltage triggers, which change state for different conditions. Used with LRR (Long Range Radio) equipment or other devices such as a remote keypad sounder, keyswitch ARMED and READY LEDs, or a printer to print the system's event log.
10. Event Log – The System shall maintain a log of different event types (enabled in programming). The event log shall provide the following characteristics:
    a. Stores up to 512 events.
    b. Viewable at the keypad or through the use of Compass software.
    c. Printable on a serial printer using a 4100SM Module including zone alpha descriptors.
    d. Stores PassPoint access control events.
    e. Sends printed events to up to eight alpha numeric pagers.
11. Scheduling - Provides the following scheduling capabilities:
    a. Open/close schedules (for control of arming/disarming and reporting).
        I. All Partitions shall auto-arm. Time to be determined by each site.
    b. Holiday schedules (allows different time windows for open/close schedules).
    c. Timed events (for activation of relays, auto-bypassing and un-bypassing, auto-arming and disarming, etc.).
    d. Access schedules (for limiting system access to users by time)

e. End User Output Programming Mode (provides 20 timers for relay control).
f. The system shall automatically adjust for daylight savings time.

12. Communication Features - Supports the following formats and features for the primary and secondary central station receivers:
    a. Formats
        I. ADEMCO Contact ID point by point reporting will be used on all District systems.
    b. Backup reporting – The system shall provide backup reporting via the following:
        I. Backup reporting will be done by phone line (DACT1) from the Fire Alarm Control panel. Insure FACP has line seizure ahead of Burg panel.
    c. Internet reporting – The system shall be installed with a 7845i-ENT communicator capable of communicating with Jeffco Alarm Center's existing 7810iR-ENT alarm receiver via the District intranet WAN. It shall provide the user with the ability to control the system via a existing Compass interface. All packet data transmitted to the monitoring station shall be encrypted with a minimum of 1024 bits of
13. Programming - The Control shall be capable of being programmed locally or remotely using the ADEMCO Compass Downloader and shall be capable of:
    a. Uploading and downloading all programming information using the 7845i-ENT communicator.
    b. Uploading and displaying firmware revision levels from the control.
14. Panel Linking - The Control shall be capable of being networked together with up to eight other controls and being operated by any keypad within the system. It shall provide the ability for users to:
    a. Control multiple zones, partitions, and/or buildings from a central location.
    b. Check status, arm and disarm any partition from any keypad in the system.
    c. Globally arm or disarm partitions based upon user authority.
15. The security surveillance system shall be capable of interfacing with additional facility systems such as access control system and fire alarm.
    a. System shall be capable of being armed and disarmed by the access control system using a key switch function.
    b. The system shall be capable of a master arm and disarm through the access control system from the District Security Office.
    c. The system shall be capable of broadcasting the system status to the paging system through the Elk 124v2 voice module.
        I. Message 1 – Security System Lock Down Warning
        "Lockdown, Locks, Lights Out Of Sight." Repeat 3x
        II. Message 2 – Security System Arming Warning
    "Your attention please,,, your attention please, the security system is arming please exit the building or contact District Security. Repeat 3x"
        III. Message 3 – Security System Intrusion Alarm Warning
    "Your attention please,,, your attention please, the security system is in alarm, contact District Security immediately." Repeat 3x"
        IV. Message 4 –"Secure Perimeter" play 3 times

B. Voice Annunciator

1. Elk 124-V2, eight channel voice record/playback Annunciator, capable of recording and playing back eight different messages. Each message shall be able to be up to 90 seconds long. The unit shall have an integrated microphone, record pushbutton, and playback volume control.

C. Exit Alarms

1. Doors requiring exit alarms shall be equipped with the Detex EAX-500 Surface Mounted Exit

Alarm (Service Key #14). When using on multiple doors (4 maximum) contractor shall install the Detex unit on the side of the doors and provide door contacts for each door. Door Contacts shall be installed per Division 28 13 00.

2.2 ENCLOSURE

A. The Control Panel shall be enclosed in a metal cabinet, suitable for wall mounting. The dimensions shall not exceed 14.5 inches (36.8 cm) in height, 12.5 inches (31.8 cm) in width or 3 inches (7.6 cm) in depth. Refer to District DCAD for layout and Panduit requirements.

2.3 ELECTRICAL POWER REQUIREMENTS

A. System Power – The Fire and Burglary Alarm System shall operate using standard 120 volts AC, 50/60 Hz power.

1. Control Primary Power – Transformer power shall be 16.5 VAC, 40VA.
2. Backup Battery – A rechargeable 12 VDC, gel type, lead acid backup battery shall be provided. The battery shall be rated between 7 and 34-ampere hours (AH).
3. Alarm Power – Alarm power shall be 12 VDC, 1.7 amps for each bell output
4. Auxiliary Standby Power – Standby power shall be 12 VDC, 750 mA maximum.
5. Fusing – The battery input, auxiliary, and bell outputs shall be protected using PTC circuit breakers. All outputs shall be power limited.

2.4. ENVIRONMENTAL CONDITIONS

A. Environmental Conditions – The Fire and Burglary Alarm System shall be designed to meet the following environmental conditions.

1. Storage Temperature – The system shall be designed for a storage temperature of -10° C to 70°C.
2. Operating Temperature - The system shall be designed for an operating temperature of 0° C to 50°C (32° F to 120°F).
3. Humidity - The system shall be designed for normal operation in an 85% relative humidity environment.
4. Electromagnetic Interference – The system shall meet or exceed the requirements of FCC Part 15, Class B devices, FCC Part 68, IEC EMC directive.

2.5 INTERIOR MOTION DETECTORS:

A. Shall be Dual Technology type, providing microwave and passive infrared sensing.
B. Shall be manufactured by Honeywell.
C. Shall be installed in the following locations:
   1. Interior hallways outside classrooms
   2. Hallways at building exits
   3. Main Office
   4. Principal’s Office
   5. Financial Office
   6. Communications Rooms (MDF and IDF)
   7. Gyms
   8. Libraries
   9. Cafeterias
   10. Computer Labs
   11. Instrument Storage areas

12. Any area where there is a high concentration of expensive equipment
13. Facility manager's office (if requested)

D. The following models are permitted, as required for application:
    1. DT8050
    2. DT8050ASN (May be used in surface mount locations only to avoid back box for SIM)
E. The motion sensor sensitivity shall be set to "medium", and the microwave must be adjusted to the installed environment.
F. Should the Contractor desire to utilize other sensors, written request to the District's Project Manager must be submitted for review and approval. The criteria for motion detection sensors are as follows:
    1. The detector shall be able to detect an intruder in a long-sleeved shirt, slacks and shoes, which weighs 100 lbs or less, and is 5-feet tall or less
    2. Standard intruder movement is defined as any movement such as walking, running, crawling, rolling, or jumping through a protected zone in the in the most advantageous manner for the intruder.
    3. Shall be Duel tech motions listed for burglary application.

PART 3 EXECUTION

3.1 EXAMINATION

A. Submission of a proposal confirms that the Contract Documents and site conditions are accepted without qualifications unless exceptions are specifically noted.

B. The site shall be visited on a regular basis to appraise ongoing progress of other trades and contracts, make allowances for all ongoing work, and coordinate the requirements of this contract in a timely manner.

3.2 INSTALLATION

A. The System shall be installed and tested in accordance with the Manufacturer's Installation instructions. The following conditions are applicable: Refer to Division 280500 for additional requirements.

1. In order to ensure a complete, functional System, for bidding purposes, where information is not available from the Owner upon request, the worst case condition shall be assumed.
2. Interfaces shall be coordinated with the Owner's representative, where appropriate.
3. All necessary backboxes, pullboxes, connectors, supports, conduit, cable, and wire shall be furnished and installed to provide a complete and reliable System installation. Exact location of all boxes, conduit, and wiring runs shall be presented to the Owner for approval in advance of any installation.
4. All conduit, cable, and wire shall be installed parallel and square with building lines, including raised floor areas. Conduit fill shall not exceed forty percent (40%). All wires shall be gathered and tied up to create an orderly installation.
5. Bridal rings and sleeves shall be marked with green paint for security paths.

3.3 TESTING AND CERTIFICATION

A. The Contractor shall demonstrate the functionality of the System upon completion of installation, documenting the result of all tests and providing these results to the Owner. The System shall be tested in accordance with the following:

1. The Contractor shall conduct a complete inspection and test of all installed equipment. This includes testing and verifying connection to equipment of other Divisions.
2. The Contractor shall provide staff to test all devices and all operational features of the System for witness by the Owner's representative and the Authority having jurisdiction. The Contractor shall provide two-way radio communications to assist in the testing. All testing must be witnessed by the owner's representative, prior to acceptance.
3. The testing and certification shall take place as follows:
    a. System shall be tested in conjunction with the manufacturer's representative.
    b. All deficiencies noted in the above test shall be corrected.
    c. Test results shall be submitted to the consultant or owner's representative.
    d. System test witnessed by owner's representative and correction of any deficiencies noted.
    e. The owner's representative shall accept the System.
    f. System test shall be witnessed by the Authority having Jurisdiction, and any deficiencies that are noted shall be corrected.
4. A letter of certification shall be provided to indicate that the tests have been performed and all devices are operational.

3.4 TRAINING

A. Provide the services of a factory-certified service representative to demonstrate the system and train Owner's maintenance personnel as specified below:
    1. On-Site Training: Provide a minimum of two (2) hours of on-site training of the facility's school staffing in the basic operations and functionality of the access control / security system panel, and field devices. Review field panel locations, typically device locations, and 120vAC power locations (panels, breakers, and circuits). Demonstrate the various system responses to the field off-normal conditions. Simulate card access conditions, supervisory conditions, security conditions, trouble conditions, and ground fault conditions of the various field devices. Provide written instructions of basic system operating instructions in the Card Access System Logbook, located adjacent to the access control-panel.

B. On-Site System Training shall be completed within six (6) days of completion of the system and final system commissioning test. Off-Site System Training shall be completed within thirty (30) days of completion of the system, unless the District specifically directs an alternate training schedule.

C. Schedule On-Site Training with the District at least three (3) days in advance.

END OF SECTION

SECTION 28 23 00

VIDEO SURVEILLANCE

PART 1 GENERAL

1.01 SYSTEM DESCRIPTION:

1. A complete Video Surveillance system designed to provide broad and specific video coverage and recording of District facilities for the purpose of site and building security monitoring.
2. Installation Locations: Typical locations identified in the District Technical Details Drawings.

1.02 QUALITY CONTROL:

1. Regulatory Requirements:
    a. National Electrical Code (NEC)
    b. Electronic Industry Association ANSI/EIA/TIA
    c. National Electrical Manufacturers Association (NEMA)
    d. Underwriters Laboratories UL 294, UL 639, and UL 1037, UL 1076
    e. National Fire Protection Association (NFPA)
    f. Federal Communications Commission (FCC) 47 CRF Part 15 and 90
    g. Applicable Federal, State, and Local Laws, Regulations, and Codes
2. System vendor shall be responsible for a complete and operating system, including constructability, functionality and maintainability of the system components.
    a. All vendors providing services shall be pre-approved by the District.
        i. A list of Pre-Qualified Vendors is available from the District Project Manager.
    b. System designers and installers manufacturer-trained and certified for the proper installation of the manufacturer's equipment and be thoroughly familiar with all aspects of the software and control hardware.
    c. The contractor must have a minimum of 3 qualified and factory-trained technicians to support this system.
    (1) System shall be installed and tested to ensure all components are fully compatible as a system and can be integrated with all associated security subsystems, whether the security system is stand-alone or a part of a complete system.
3. Training: On-site system training from a qualified factory representative to include troubleshooting. Include both maintenance and end user.
    a. Provide training at both a user and administrative level on the use, maintenance and configuration of the system/software proposed.
    b. Small groups of 5 at school/remote sites and groups of up to 25 at administrative sites.
    c. Minimum 2 hours of technical training in system setup, maintenance, troubleshooting, and service of the system.
4. Local support for the proposed product as well as software/hardware needs to be available locally through a minimum of two sources.
    a. Local resources must be able to provide service agreements should the Owner elect to contract these services.
    b. Warranty Issues: Maximum 24 hour response time during normal business hours.
5. Operation and Maintenance Manual: At a minimum, provide:
    a. As-built record drawings, Equipment Operations and Manuals containing all technical information on each piece of equipment, electronic (PDF format), and printed sets:
    b. Reference Consultant Guidelines for Close-Out Documentation and Quantities.
6. Commissioning:
    a. Provide a complete schedule of all system components listing:
        i. Final assigned IP address
        ii. Final assigned Host Name

iii. Hardware serial number
iv. Hardware MAC Address
v. Patch Panel Port
vi. Programming sheets for all associations between cameras and door alarms.
vii. Final test report of all system components and operation
Graphical maps for the alarm monitoring screens. Maps shall include the locations of all equipment and components.

b. A complete schedule of all system components noting their installed locations and any variance in equipment from original specification following the District-provided format.

7. Warranty Period
    a. One year from date of Acceptance by the District
8. Installing vendor shall schedule a site visit one month after Acceptance to review issues and adjust cameras as requested by the District. Reference Divisions 26, 27 and 28 of the District's Technical Guidelines for other requirements
9. Contractor Testing
    a. The contractor shall demonstrate that all cameras are providing good video quality and the field of view of the cameras is as expected in the design documents. The contractor shall adjust all manual lenses for focus and zoom to the complete satisfaction of the users.
    b. The contractor shall develop a report that indicates a complete listing of all equipment and cameras in this facility. This list shall be used as a guide during testing to ensure that all components are inspected. The personnel conducting these tests shall indicate the following information on this form:
        i. Name and position of person conducting test
        ii. Date of Test
        iii. Time of Test
        iv. Results of Test
10. Preparation for Final Acceptance Testing
    a. All components shall be inspected to ensure they have been properly installed, securely attached, and remain clean and unmarred.
    b. All equipment shall be properly adjusted, clearly labeled, and fully operational.
    c. All broken, damaged, or modified items such as walls, doorframes, ceiling tiles, etc., shall be replaced or properly repaired to the satisfaction of the District.
    d. All extra or spare materials shall be delivered and stored on the premises as directed.
    e. Test report of all system components shall be completed and available for inspection as indicated herein.
11. Final Acceptance Testing
    a. After testing reports, as-built drawings, and required manuals have been submitted for review, the Contractor shall coordinate a date for Final Acceptance Testing.
    b. Testing and acceptance of this system will take place in the presence of the Consultant and the Owner.
    c. Acceptance of the system shall require a demonstration of all system components to evaluate their performance and reliability. Prior to this test the system must have been online for a period of sixty (60) days, with an uptime of no less than 99%. Should a major equipment failure occur, the Contractor shall replace the defective component and re-test as necessary. Any items discovered during final inspection which require the contractor's attention, shall be promptly addressed. These items will then be re-inspected by the Consultant and Owner for approval.
    d. Upon Contractor completion and Owner acceptance of the Final Acceptance Testing the Contractor shall submit all finalized project documentation and associated electronic media, incorporating any changes as a result of the testing.

1.03 SYSTEM FUNCTIONALITY

1. New Systems: Provide design, equipment, installation, training, and ongoing support of a new system.
2. Existing Systems: Provide design, equipment, installation, training, and ongoing support of new components in existing system.
    a. Vendor shall remove old cable and power supply as necessary to convert older systems and cameras to District IP system and cameras.
    b. All components shall be compatible with existing software systems.
3. General:
    a. Capable of managing the latest technology IP based cameras as well as the Districts older analog closed circuit TV type cameras.
4. Minimum Requirements
    a. System must be expandable
    b. All devices installed shall comply with Division 27 requirements.
    c. Operate with support for automatic detection of cameras, encoders and NVRs in the same broadcast domain.
    d. Have multi-streaming support including different frame rate, bit rate, resolution, quality and compression format from an individual camera and user.
    e. Have a built-in web server to make video and configuration available in a standard browser environment; the built-in web server shall support multiple users with different permission levels and unique usernames and passwords as derived from the District's Active Directory user management systems
    f. Support user configuration (remote) of network parameters including: Static IP address, Subnet Mask, Gateway, and Control Port for control communications;
    g. Support user configuration (remote) of camera parameters including: Camera Name, Location and Logical ID;
    h. Support user configuration (remote) of image acquisition parameters including: Exposure Control, Flicker Control, Iris Control, Day/Night Control, White Balance Control, Color Saturation and Sharpening;
    i. Support a mode that automatically removes the IR filter and enters a monochrome mode when the available light drops below a set threshold;
    j. Support user configuration of an unlimited number of independent motion detection zones within the camera field of view;
    k. Support user configuration of privacy zones within the camera field of view
    l. Support remote zoom and focus control of the lens and performing automatic focus
    m. Support user configuration (remote) of compression format, compression quality, maximum bit rate, key frame interval, and image rate per individual camera
    n. Have input/output terminals for connecting alarm inputs and alarm outputs
    o. Have an audio input for connecting external microphones
    p. Have a video output for connecting external monitors
    q. Support UDP transport
    r. Capability of remote upgrading over an IP network for feature enhancements utilizing manufacturer's native head end equipment.
5. Design and Performance
    a. Push live and recorded video to mobile internet users without the need for a preconfigured client
    b. Local storage using existing NVR / Server at each site.
    c. Provide an individual, interactive map accessible from any console.
        (1) Maps shall be updated when a new camera is added, deleted, or an existing camera is relocated.
6. Licensing
    a. Provide licenses for all components that require licenses
7. Schedule
    a. Provide the following number of cameras at each facility:

b. Elementary Schools: 8
c. Middle Schools and K-8's: 16
d. High Schools and 7-12: 32

1.04 SURVEILLANCE DIGITAL VIDEO RECORDING SYSTEM – BY OWNER

8. The surveillance digital video recording system shall be capable and able to integrate with the existing Owner access control system.
9. Provide and install the latest approved software on the designated Owner server.
10. The system shall be capable of recording all cameras in the system for a period of 30 days.
11. The system shall have an IP connection to be accessible through the Owner's security network

1.05 INTEGRATED FIX COLOR DOME IP CAMERA - INTERIOR

12. Self-contained Day/Night indoor vandal resistant IP dome with POE power compatibility.
13. Video output streams: H.264 and Motion JPEG (MJPEG).
14. Minimum Resolution required: 35 pixels per foot.
15. Minimum frame rate of 6/second.
16. Support manual and automatic white balance control, manual and automatic iris control,
17. Automatic and manually defined exposure zones, automatic and manual day/night control, motion detection sensitivity and threshold, back light compensation, manual rotation of the image.
18. Equipped with either a 3-9mm OR 9-22mm varifocal lens depending on the required field of view shown on the project drawings.
19. Equipped with an automatically and manually removable IR-cut filter.
20. IP66 rated housing, operating range of 14 degrees F to 122 degrees F
21. Manufacturer: Avigilon Model# XX-H3--DX series. (MP rating and focal lens required dependent on meeting or exceeding the required viewing length/width shown on the drawings).
22. 180 deg. and 360 deg. cameras shall be JPEG2000 HD Panoramic Camera or H.264 HD Multi-sensor Cameras
    a. Avigilon, Model # 9W-H3-3MH-DC1
    b. Avigilon Model # 12W-H3-4MH-DC1

1.06 BULLET CAMERAS - EXTERIOR:

23. Self-contained Day/Night outdoor vandal resistant IP bullet camera with POE power compatibility and integral heater.
24. Video output streams: H.264 and Motion JPEG (MJPEG).
25. Minimum Resolution required: 35 pixels per foot.
26. Minimum frame rate of 6/second.
27. Support manual and automatic white balance control, manual and automatic iris control, automatic and manually defined exposure zones, automatic and manual day/night control, motion detection sensitivity and threshold, back light compensation, manual rotation of the image.
28. Equipped with adaptive IR Illuminator and either a 3-9mm OR 9-22mm varifocal lens depending on the required field of view shown on the project drawings. Camera must provide uniform illumination in the dark, 0 lux, up to the maximum distance shown on the drawings.
29. Equipped with an automatically and manually removable IR-cut filter.
30. IP66 rated housing, operating range of -40 degrees F to 122 degrees F
31. Manufacturer: Avigilon Model# 3.0C-H3A-BO1-IR camera series. (MP rating and focal lens required dependent on meeting or exceeding the required viewing length/width shown on the drawings).

1.07 SURGE PROTECTION

32. All CCTV components mounted outside the building shall be provided with surge and lightning protection. Provide UL listed multi-stage protection on all low voltage and signal transmission lines.
    a. Provide at camera locations on all exterior cable runs.
    b. Shall be grounded to the ground bus within the MDF Room.

- Cable for CCTV Systems
- Reference Division 27 for cabling requirements and labeling.

END SECTION

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SECTION 28 46 00

FIRE ALARM DETECTION SYSTEM

PART 1 – GENERAL REQUIREMENTS

1.1 GENERAL REQUIREMENTS

A. The requirements of the Contract Documents, including the General and Supplementary General Conditions, and Division 1 General Requirements shall apply to work of this Section.

B. At the time of bid, all exceptions taken to these Specifications, any variances to the contract drawing design, and any nonconformance to the operating capabilities called for in this specification, shall be listed in writing and forwarded with the submission of the bid. Any such exception, variance, or nonconformance, which was not listed at the time of bid, and is identified in the submittal, shall be grounds for immediate disapproval without comment.

C. Fire Alarm manufacturer shall be required to provide Jefferson County Public Schools a licensed copy of any software required to download, modify and maintain the system. Programming access codes shall not be given to the District until after the warranty period.

1.2 SCOPE

A. The work covered by this Section of the Specification shall include all labor, equipment, materials, and services to furnish and install a complete fire alarm security and detection system of the zoned, non-coded general alarm type. It shall be complete with all necessary hardware, software, and memory specifically tailored for this installation. The system shall consist of, but not be limited to, the following:

1. Fire Alarm control panels.
2. Annunciator panels.
3. Addressable manual fire alarm stations.
4. Analog/Addressable automatic initiating devices.
5. Fire alarm signaling devices.
6. Auxiliary fire alarm equipment and connections.

1.3 RELATED SECTIONS

A. Section 07 80 00: Fire and Smoke Protection

B. Section 08 71 00: Door Hardware

C. Section 21 10 00: Water Based Fire Suppression Systems

D. Section 23 33 00: Air Duct Accessories

E. Section 26 05 00: Common Work Results For Electrical Systems

F. Section 26 05 19: Low Voltage Electrical Power Conductors and Cables

G. Section 26 05 26: Grounding and Bonding for Electrical Systems

H. Section 26 05 29: Hangers and Supports for Electrical Systems

I. Section 26 05 33: Raceways and Boxes for Electrical Systems

J. Section 26 05 53: Identification for Electrical Systems

K. Division 27: Communications

L. Jefferson County School District Technical Details Drawings, Volume II

M. Section 28 05 00: Common Work Results For Electronic Life Safety and Security

1.4 APPLICABLE CODES AND STANDARDS

A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or Regulations referenced in this Section, and with the following Codes and Standards, as applicable:

1. All equipment shall be listed and classified by Underwriters Laboratories, under the following standards:
    a. Signaling Systems
    b. UL 228 – Door Closers-Holders, With or Without Integral Smoke Detectors
    c. UL 639 – Intrusion – Detection units
    d. UL 268 – Smoke Detectors of Fire Protective Signaling Systems
    e. UL 268A – Smoke Detectors for Duct Applications
    f. UL 464 – Audible Signal Devices for Fire Alarm and Signaling Systems, Including Accessories
    g. UL1638 – Visible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories.
    h. UL 1480 – Speakers for Fire Alarm and Signaling Systems, Including Accessories.
    i. UL 38 – Standard for Manual Signaling Boxes for Fire Alarm Systems.
    j. UL 346 – Standard for Waterflow Indicators for Fire Protective Signaling Systems.
    k. UL 521 – Standard for Heat Detectors for Fire Protective Signaling Systems.
    l. UL 1481 – Standard for Power Supplies for Fire-Protective Signaling Systems.
    m. UL 1711 – Standard for Amplifiers for Fire Protective Signaling Systems.
    n. UL 521 – Heat Detectors for Fire Protective Signaling Systems.
    o. UL 864 – Control Units for Fire Protective Signaling Systems.
    p. UL 1076 – Proprietary Burglar Alarm Units and Systems.
    q. UL 1971 – Signaling Devices for the Hearing Impaired.
    r. FM P7825a – Approval Guide Fire Protection
    s. NFPA 70 - National Electrical Code Current Version adopted By the AHJ.
    t. NFPA 72 - National Fire Alarm Code Current Version adopted By the AHJ.
    u. IFC - International Fire Code. Current Version adopted By the AHJ.
    v. IBC International Building Code. Current Version adopted By the AHJ.
    w. IMC – International Mechanical Code. Current Version adopted By the AHJ.
    x. ANSI S3.41 – Audible Emergency Evacuation Signals.
    y. EIA ANSI/EIA/TIA2323 – Interface between Data Terminal Equipment and Data Circuit Terminating Equipment employing Serial Binary Data Interchange.
    z. IEEE C6.41 – Surge Voltages in Low Voltage AC Power Circuits.
    aa. Division 1 – Jefferson County Public Schools Technical Guidelines.
    bb. Local AHJ Amendments.
    cc. Americans with Disabilities Act (ADA)

1.5 SPECIAL REQUIREMENTS

A. Definitions: “Furnish” shall mean “provide and install”. “Provide” means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application. “Install” means to join, unit, fasten, link, attach, set up or otherwise connect together before testing and turning over to Owner, complete and ready for regular operation. The words “accept” or “acceptable” denote only that the equipment items are in general conformance with the design concept of the project

1.6 SUBMITTALS

A. Reference 01 33 00 – Submittal Procedures.

1. Shop Drawings: Provide shop drawings in compliance with NFPA 72 Chapter 7 including:
    a. Wiring diagrams showing all equipment, device placement, and wiring connection required.
    b. One-line riser diagrams.
    c. Device ID numbers (manufacturer’s format), room numbers, room descriptors, and compass direction (if applicable).
    d. Zone schedules, operational matrix, and location of all end-of-line (EOL) devices.
    e. Each initiating device and notification appliance device shall include signaling loop circuit or notification appliance circuit number and device ID numbers (manufacturer’s format).
    f. All system wiring shown on the floor plans.
    g. Include fire alarm control panel elevation view.
2. Product Data: Provide manufacturer’s data sheets showing product appearance, electrical characteristics, and connection requirements.
3. Load Calculations: Provide load calculations for all visual appliance circuits, audible notification appliance circuits, audible/visual notification appliance circuits, system power supplies, and battery standby systems.
4. Control Panels and Power Supply: Show fire alarm control panel layout, configurations, and terminations.
5. Manufacturer’s Installation Instructions: Indicate application conditions and limitations of use, as stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and start-up of products.
6. Submittals shall be reviewed and approved by architect, engineer and owner prior to submittal to AHJ.
7. Exceptions: Provide a detailed listing of any and all exceptions, variances, and non-conformances to the specifications and contract design drawings. Failure to disclose any such items shall be grounds for immediate disapproval of submittals without comment.
8. Samples: Provide samples of various items, when requested.
    a. Provide a minimum of two (2) samples of all fire alarm cable to be installed on the projects. Cable samples shall be of sufficient length to identify cable marking (striping) and cable listing identification.
    b. Provide a minimum of two (2) samples of all cable supporting devices, metal bridle rings, metal mounting brackets, plastic plenum rated wire bushings, and other applicable cable installation equipment to be utilized on the project.

1.7 CLOSEOUT SUBMITTALS

A. Reference 01 77 00 Closeout Procedures

B. Record Drawings

1. Record “as-built” locations of all system components, initiating devices, signaling appliances, and end-of-line devices. Include “as-built” conduit routing and wire counts. The design

engineer and Jefferson County representative shall walk through the building and spot check 5-10% of device locations against the as-builts. If devices are not as shown, drawings will be rejected for a redraw. Upon resubmittal, another spot check will be performed. If deficiencies are found on the second check, an independent audit to the system by the system manufacturer shall be required. The contractor shall bear the cost of any such audit.

2. As-Built drawings shall consist of two hard copy bond sets and one electronic AutoCAD file copy on CD or flash drive format.
3. As-Built system load and battery calculations shall consist of two full size hard copy bond sets and one electronic copy on CD or flash drive format. Load calculations shall include all audible, visual, and audible/visual notification appliance circuits with calculated voltage drop levels, calculated maximum circuit distance measurements, actual recorded circuit length distance measurements, and actual measured voltage drop levels.
4. Provide electronic copy of all excel files (i.e. calculations, sequencing matrix, legend, etc.).
5. Provide two (2) hard copies of all system programming (software).
6. Provide two (2) electronic copies of all system programming (software); on CD ROM or flash drive format.
7. Provide Contractor redline construction drawing set, with mark-ups.
8. Provide two (2) full size hard copy bond sets of As-Built record drawing set.
9. Provide one (1) 11x17 hard copy bond sets of As-Built record drawing set.
10. Provide one (1) electronic copy of As-Built record drawing sets; on CD or flash drive format.
11. Provide all special test equipment, filters, test leads, cords, etc. required to test the system.
12. Record document box shall be located adjacent to FACP and shall contain contractor working set (actual field set – not cleaned up version) along with electronic copies as indicated above.

C. Operation and Maintenance (O&M) Manuals

1. Operational Data: Provide operating instructions, detailed for the specific project.
2. Maintenance Data: Provide maintenance and repair procedures for each type of equipment provided, as applicable. Include any specific requirements particular to the project.
3. Equipment Data: Provide manufacturer data sheets or catalog sheets for each type of equipment provided.
4. Spare Parts Data: Provide manufacturer's recommended spare parts list, including quantity, and any equipment replaced schedules, as applicable.
5. Supplier Data: Provide system manufacturer and local service organization information. Include contact, phone numbers, and addresses, as applicable.
6. Warranty Data: Provide system warranty information, including all material and/or labor terms.

D. Warranty

1. The manufacturer shall guarantee the system equipment for a minimum period of one (1) year from the date of final acceptance of the system. Any additional warranty periods shall be listed in the Operation and Maintenance Data manuals. Any defective equipment, material, or software shall be replaced at no cost to the Owner during this warranty period.
2. The installing contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for a minimum period of one (1) year from the date of final acceptance of the system. Any defective material and/or labor shall be replaced at no cost to the Owner.

E. Maintenance Service

1. Furnish warranty service and maintenance of the fire alarm system for one (1) year from the date of final acceptance of the system, as follows:
    a. Basic Services: Systematic, routine maintenance visits, as required; at times

coordinated with the Owner. In addition, respond to service calls within 24 hours of notification of system trouble. Adjust and replace defective parts, components, and supplies.

b. Additional Services: Perform services within the above two (2) year period, not classified as routine maintenance or as warranty work, when authorized on writing by the Owner. Compensation for additional services shall be agreed upon in writing, prior to performing and additional services.

F. Field Modifications

1. Include pricing for field changes in bid, as follows:
    a. Provide 5% analog/addressable manual stations minimum 1.
    b. Provide 5% of each type of automatic smoke or heat detector minimum 1.
    c. Provide 5% of each type of smoke or heat detector base minimum 1.
    d. Provide 5% of each type of audible, audible/visual, or visual notification appliance minimum 1 of each.
    e. Provide 5% of each type of addressable monitor module minimum 1.
    f. Provide 5% of each type of addressable control module minimum 1.

G. Spare Parts

1. Provide extra materials, as follows:
    a. Provide 5% analog/addressable manual stations minimum 1.
    b. Provide 5% of each type of automatic smoke or heat detector minimum 1.
    c. Provide 5% of each type of smoke or heat detector base minimum 1.
    d. Provide 5% of each type of audible, audible/visual, or visual notification appliance minimum 1 of each.
    e. Provide 5% of each type of addressable monitor module minimum 1.
    f. Provide 5% of each type of addressable control module minimum 1.
    g. Provide six (6) of each type of key.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this section with a minimum three (3) years' experience, and with service facilities within fifty (50) miles of the project.

B. Shop Drawing Preparer: Company shall employ a NICET level 3 or 4 shop drawing preparer. Preparer shall sign shop drawing submittal.

C. Project Supervisor: The installing company shall provide a full time project supervisor dedicated to the supervision of the fire alarm installation. The project supervisor shall have at least 5 years of experience installing addressable fire alarm systems. The project supervisor shall be on site at all times that the fire alarm system installation is in progress, including system testing.

D. Project Engineer: Company shall employ an engineer of record with a registered P.E. in fire protection engineering, or a registered P.E. in a related engineering discipline, with a minimum of four (4) years' experience in fire protection and alarm engineering, or a minimum NICET Level 3 Project engineer.

E. Installer: Installing Company shall use only District Approved Premier level Notifier dealer or JCI dealer for programming and final testing. The Bidding Company must specialize in installing the products specified in this section with a minimum three (3) years documented experience. The installer shall employ NICET Level 2 trained technicians to install the products specified in this Section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with specified requirements, products of the following manufacturers shall be acceptable:
   1. Base Bid: Shall be based upon Simplex 4100ES.
   2. Substitutions: No substitutions allowed.

2.2 MATERIALS

A. FIRE ALARM CONTROL PANEL

   1. The fire alarm control panel shall incorporate all control electronics, relays, necessary modules, and components in a semi-flush mounted cabinet. The operating controls and zone/supervisory indicators shall be located for the Fire Department and other authorized operating personnel. The fire alarm control panel shall consist of a base panel, system power supply, and battery charger, with optional modules suitable to meet the requirements of these specifications.
   2. The fire alarm control panel shall be supervised, site programmable, and of modular design with expansion modules to provide analog addressable loop modules as required. Allow for 20% spare on both detector and modules. The expansion modules be configurable to either Class A or Class B wiring.
   3. The fire alarm control panel shall store all basic system functionality and job specific data in nonvolatile memory, and shall survive a complete power failure intact. The fire alarm control panel shall be capable of automatic system operation with support of alarm silence, trouble silence, drill, lamp test and reset common controls. The fire alarm control panel shall allow downloading of job specific custom programming, and shall support programming of any input point to any output point, or using initiating events to start actions and sequences.
   4. The fire alarm control panel shall utilize full digital communications to supervise all addressable loop detectors and modules for proper operation. The fire alarm control panel shall have a UL Listed Detector Sensitivity test feature, and shall support 100% of all remote detectors, remote alarm indicators and modules in alarm at any time.
   5. The fire alarm control panel shall supervise all system modules for placement, and shall have a digital display for reporting system status and abnormal conditions. The fire alarm control panel shall provide common control indicators (normal, alarm, monitor, ground fault, supervisory, trouble), common control switches (reset, alarm silence, trouble silence, and drill), and zone alarm and trouble LEDs, as required for the system zoning requirements. The fire alarm control panel shall provide system function keys for status, reports, enable, disable, activate, restore, program and test.
   6. Provide a District approved Fire Alarm Document Enclosure adjacent to the FACP.
   7. Provide a wall mounted 3 ring binder holder for District provided Fire Alarm Log Book adjacent to the FACP.

B. Power Supplies:

   1. The fire alarm power supply shall be switch mode type with line monitoring to automatically switch to batteries upon power failure or brown out conditions, and shall be adequate to service all control panel modules, all fire alarm system powered smoke sensors and modules, remote annunciators, control relays, and all fire alarm signaling appliances. The fire alarm power supply shall contain an integral battery charger capable of recharging the standby batteries per NFPA 72 requirements, and shall provide battery supervision for placement and low voltage.
   2. Provide booster power supply panels as required, to meet project requirements. The booster

power supply shall activate via dry contact from the fire alarm control panel. The booster power supply shall generate a fault condition at the main fire alarm control panel, when any fault condition occurs on circuits connected to the booster power supply, or a trouble condition occurs at the booster power supply panel. The booster power supply shall contain an integral battery charger capable of recharging the standby batteries per NFPA 72 requirements, and shall provide battery supervision for placement and low voltage.

3. Multiple power supplies may share monitor and control modules ONLY if they are mounted in the same room, not to exceed 3 power supplies per monitor point. Activation of a power supply from another power supply is not permitted.
4. Provide a dedicated booster power supply for 24VDC magnetic door holders. Configure power supply for control only. Do not monitor this power supply and do not provide batteries as magnetic door holders are fail safe.
5. Provide a dedicated booster power supply for NAC modular classroom NAC circuits.

C. Standby Batteries: The secondary power source shall be standby batteries. Batteries shall be sealed lead acid type, with a minimum life expectancy of five years, and shall provide twenty four (24) hours of normal standby operation and five (5) minutes of normal alarm condition at the end of the standby period. System can use four (4) hour battery system if the site has an Automatic-starting, engine-driven generator serving the dedicated branch circuit of the fire alarm system arranged in accordance with NFPA 72 10.5.10.3.1

1. Batteries shall be dated with month and year of installation in the system as well as manufacture date.
2. Dedicated battery cabinets (when required) shall be located below the fire alarm control panel. Do not locate these panels above finished ceilings.

D. System Design Parameters:

1. Design the fire alarm system such that each power supply, initiating device (IDC) circuit, device initiating signaling loop (SLC) circuit, audible/visual notification appliance (NAC) circuit, power supply, and standby battery system shall have a minimum 20% spare capacity included.
2. Design the fire alarm system such that each analog/addressable device initiating loop (SLC) circuit shall have a minimum 20% spare capacity included.
3. Fire Alarm Loop Fault Isolation: Design the fire alarm system such that each analog/addressable device initiating loop (SLC) circuit shall incorporate isolation detector bases and/or loop fault isolation modules, placed at any location where the SLC leaves the building or enters a wet location.
4. Fire Alarm Class B Device Initiating Loop (SLC) Circuits: The analog/addressable device loop (SLC) circuit shall be power limited, electronically supervised and shall be monitored for active (short), trouble (open), and ground fault conditions. The analog/ addressable loop (SLC) circuit shall provide all power, signaling and polling communications to the analog detectors and addressable modules connected to it, and shall monitor all sensors for their analog values, environmental compensation levels, and maintenance conditions. The analog/ addressable device loop (SLC) circuit shall monitor all devices for trouble and alarm conditions and shall place the circuit in trouble mode; but shall not disable any device from initiating an alarm of trouble signal to the fire alarm control panel. The analog/ addressable device loop circuit shall be Class B (Style 4) type.
5. Class B Notification Appliance (NAC) Circuits: The notification appliance (NAC) circuits shall be power limited, electronically supervised, and shall be monitored for trouble (open and/or short) and ground fault conditions. Occurrence of a single ground condition shall place the circuit in trouble mode but shall not disable that circuit from signaling the alarm condition (audible or visual) to the field notification appliances. The alarm notification appliance circuits shall provide all power for the audible, visual, and audible/visual notification appliances, and

shall by Style Y (Class B).

6. Audible and Visual (NAC) Appliance Circuits: Provide audible and visual notification appliance (NAC) circuits, such that the visual and audible notification appliances deactivate upon system silence. Strobes shall synchronize where two or more visual notification appliances or groups of synchronized appliances in the same room or adjacent space are within the field of view.
7. Design the fire alarm system such that the Beam and Duct smoke detectors are intelligent/analog devices. Conventional devices shall not be used without written permission from the engineer and District Project Manager. If conventional devices are approved, a separate 24vDC power source that is resettable from the fire alarm control panel must be installed, as applicable.
8. Jeffco Fire Alarm System Design Criteria shall be used to provide supplemental coverage. This section shall be printed on the front page of all Fire Alarm Plans submitted to Local AHJ's. It is intended to help local AHJ's understand how the District applies additional selective coverage.

Jefferson County Public Schools
FIRE ALARM SYSTEM DESIGN CRITERIA

The fire alarm system design is based upon the following codes:

Latest versions as adopted by the State of Colorado, Division of Fire Prevention and Control.

1. International Building Code (IBC)
2. International Fire Code (IFC)
3. International Mechanical Code (IMC)
4. National Electrical Code (NEC)
5. National Fire Alarm Code (NFPA 72)
6. Elevator Safety Code (ANSI A17.1)
7. Americans with Disabilities Accessibility Guidelines (ADAAG)
8. State of Colorado Requirements
9. Jefferson County Public Schools Division 28 Technical Guidelines

In addition to the state and code requirements, the fire alarm system design incorporates the following additional design criteria:

Smoke Detection:

1. Smoke detectors shall be located in all electrical rooms, air handling equipment rooms, and other similar code required areas.
2. Smoke detectors shall be located throughout all common corridors, gyms, cafeterias, and libraries.
3. Smoke detectors shall be located in all MDF, IDF and other communication type rooms.
4. Smoke detectors shall be located at the fire alarm control panel.
5. Smoke detectors shall be located at all fire alarm remote power supply panels.
6. Smoke detectors shall be located at all distributed amplifier panels.
7. Smoke detectors shall be located in all kindergarten classrooms.
8. Smoke detectors shall be located in all special education classrooms, and other areas where special needs students would normally be located.
9. Smoke detectors shall be located in all computer classrooms.
10. Smoke detectors shall be located in all auditoriums.

11. Smoke detectors shall be located in elevator lobbies, elevator machine room, and the top of shaft for elevator control purposes as allowed by code.
12. Only a single smoke detector is required in each modular classroom except where full detection is required for special needs classrooms or kindergarten classrooms.
13. Smoke detectors for fire/smoke damper and firefly release shall be located in accordance with IBC latest edition. Contractor shall pretest fire/smoke damper and firefly function prior to start of construction and report deficiencies to JCSD.

Heat Detection:

1. Heat detectors shall be located in all code required areas not suitable for smoke detection, and shall be intelligent, analog heat detectors.
2. 135°F rate of rise heat detectors shall be located in all chemical storage areas, science prep rooms, and science classrooms.
3. 135°F rate of rise heat detectors shall be located in all student use restrooms. Heat detectors shall be located outside of the airflow path of HVAC registers. Heat detectors that are required in small restrooms in which the detector must be located in the airflow path shall be programmed for fixed temperature. Heat detectors are not required for single toilet rooms with no sink.
4. 135°F fixed temperature heat detectors shall be located in modular classroom restrooms and mechanical closets.
5. 135°F fixed temperature heat detectors shall be located in kitchen areas.
6. Heat detectors set at the highest programmable fixed temperature possible shall be located in yard equipment storage rooms unless storage is detached from the main school building.
7. Heat detectors set at the highest programmable fixed temperature possible shall be located in all boiler rooms, chiller rooms, and other similar rooms unless sprinkled.
8. Heat detectors set at the highest programmable fixed temperature possible shall be located in the kiln room.
9. Heat detectors shall be located in the elevator machine room and top of shaft for elevator shunt trip purposes as required by state code.
10. 135°F rate of rise heat detectors shall be located in all teacher/staff lounges.
11. 135°F rate of rise heat detectors shall be located on all middle school and high school stages.
12. 135°F fixed temperature heat detectors shall be located in all home economics classrooms.

Duct Smoke Detection:

1. Duct smoke detectors shall be intelligent analog/addressable type, which shall report to the fire alarm system as a “supervisory” type device.
2. Duct smoke detectors shall be located in the return air ductwork of all HVAC units greater than 2,000 cfm. Duct smoke detectors shall be located in the return air ductwork of all HVAC systems with a combined capacity greater than 2,000 cfm.
3. Duct smoke detectors shall be located in the return ductwork of all HVAC units greater than 15,000 cfm where return air risers serve two or more stories such smoke detectors shall be installed at each story per the IMC.
4. Duct smoke detectors shall be located within five feet of each smoke damper or fire/smoke damper used for control purposes unless an alternate method from IMC 607.3.3.2 can be applied.

Manual Pull Stations:

1. Manual pull stations shall be dual action type.
2. Manual pull stations shall be located in the Main Office of the school and in a normally attended non-public location near areas for the school used after hours.
3. Manual pull stations shall be located at the exit doors in the kitchen, mechanical rooms and electrical rooms with direct exterior access.
4. Manual stations shall be mounted with the operating mechanism at 48” above finished floor.

Magnetic Door Holders:

1. New door holders shall be 24VDC and located as shown on Fire Alarm drawings and as directed by the Architect.
2. Existing magnetic door holders shall remain in place. If door holders are 120VAC, a separate heavy duty relay shall be provided outside of enclosure.
3. Magnetic door hardware shall be powered by new, dedicated remote power supplies.
4. Contractor shall remove door stops at locations of new and existing magnetic door holders.

Carbon Monoxide (CO) Sensors:

1. Carbon monoxide (CO) sensors shall be intelligent and shall report to the fire alarm system as a "GAS" Contact ID type device.
2. Carbon monoxide (CO) sensors shall have three CO exposure level settings for short, medium, and long duration periods of exposure to CO gas.
3. Carbon monoxide (CO) sensors shall have a sounder base, which shall provide a local alarm signal upon activation of any of the three CO exposure level settings.
4. Carbon monoxide detectors shall be located in kitchen, boiler room, rooms with gas fired equipment including science rooms, laboratories, gas water heaters, gas furnaces, and gas fired AHUs **or** first room served by a gas fired AHU.

Audible, Visual, and Audible/Visual Notification Appliances:

1. Speakers and speaker/strobes shall be generally located to provide a minimum of 15dB above ambient sound levels throughout all building areas.
2. Speaker/strobes shall be located in all mechanical rooms, and other high-noise areas.
3. Speaker/strobes shall be located in all classroom areas.
4. Loudspeakers and strobes shall be located in gymnasiums.
5. All speakers shall be set to the volume setting recommended by manufacturer to meet intelligibility and dB level requirements.
6. Speaker/strobes shall be located in all common "public area" spaces, including corridors, classrooms, multi-person restrooms, open office areas, and other areas where more than one-person occupancy would be expected.
7. Strobes shall be located in all single-person restrooms except single water closets (toilet only) without a sink specifically in kindergarten and pre-school classrooms.
8. Strobes shall be located in copy rooms, work rooms, storage rooms greater than 400 square feet, and storage rooms where high occupant usage levels are anticipated under normal conditions.
9. Strobes shall be located in clinics and conference rooms.
10. Strobes shall not be installed in single occupant offices.
11. Ceiling mounted speaker/strobes are preferred over wall mounted in classrooms, restrooms, and offices. Ceiling mounted speakers, strobes, and speaker/strobes shall be centered in the space as much as possible but shall not exceed 5 feet in any direction from the center, unless approved by the engineer or AHJ.
12. When ceiling mounting is not practical, speakers, strobes, and speaker/strobes shall be wall mounted with the bottom of the visual signal (strobe) lens at 80" above finished floor, or with the top of the visual signal (strobe) lens at 6" below the ceiling (for low ceiling areas), whichever is lower.
13. For specific limited applications, the speakers, strobes, and speaker/strobes may be installed with the top of the visual signal (strobe) lens at up to 96" above finished floor. Each location must be approved in writing by the engineer or AHJ.
14. Exterior weatherproof horn/strobes shall be provided at the fire department response point. The horn shall be silenceable and the notification appliance shall be mounted 10 feet above grade.

15. Exterior weatherproof loudspeakers shall be provided at main entry and any playground areas. The speakers shall be silenceable and the notification appliance shall be mounted 10 feet above grade.
16. Exterior weatherproof strobes with amber lenses shall be provided at entrances with in-bound card readers.

Speakers and speaker/strobes shall be installed in dedicated zones as required by Division 28 46 50.

END FIRE ALARM SYSTEM DESIGN CRITERIA

E. OFFSITE SIGNALING

1. Dialer: Provide digital alarm communicator transmitter (DACT) that shall transmit all control panel off normal condition, including Alarm, Water flow, Supervisory, or Trouble. The DACT shall utilize two (1) Cat6 voice line to comply with NFPA 72 requirements, shall utilize Contact ID type point-by-point communication format. The DACT shall be the latest Notifier Model UDACT, Simplex Model SDACT, or District approved equivalent transmitter (DACT). The Contractor shall provide all point-by-point programming to support transmission of all control panel off normal conditions, including Alarm, Supervisory, Water flow and Trouble.
2. Building Automation Relay Contacts: Provide separate supervisory Form “C” relay contacts rated at 120vAC at 1 Amps inductive load, for interconnection to Building Automation system for each AHU shut down function. These may be stand-alone relays or auxiliary contacts at the duct detectors.
3. Ethernet Communications: Provide Ethernet topology data communications module (LAN) that shall transmit all control panel off normal condition, including Alarm, Water flow, Supervisory, or Trouble via Email. The LAN module shall utilize a Category 6 RJ45 data Ethernet connection port for interconnection to the District LAN/WAN network. The LAN module shall support remote web browsing and email alert functions.
4. Bosch Dialer Capture Ethernet module:
    a. Extend DACT phone line from MDF 66 block to Bosch module. Phone line shall return to 66 block for connection to a leased voice line.
    b. The Bosch shall utilize a Category 6 RJ45 data Ethernet connection port for interconnection to the District LAN/WAN network.
    c. Provide B10R-1640-120WI medium control panel enclosure which includes:
        i. B46 external annunciator
        ii. A keyed lock that matches the FACP
        iii. 1640-120WI Transformer
    d. Provide three (3) fire alarm monitor modules to supervise: B465 Loss of 120VAC Power
        i. B465 Loss of 120VAC Power
        ii. B465 Battery Fail
        iii. B465 System Trouble
    e. Mount top of cabinet no higher than 6 feet above finish floor.
5. Access Control Interface:
    a. Provide the ability to monitor card access for lockdown condition. When the lockdown is active, fire alarm notification devices shall silence.
    b. Provide the ability to track the status of lockdown.

F. SUPPORT FOR INSTALLER AND OWNER PROVISIONS:

1. The fire alarm control panel shall provide a coded “self-test” test feature, capable of audible or silent testing. The “self-test” test feature shall signal alarms and troubles during test and shall allow receipt of alarms and programmed operations for alarms from other areas not

under “self-test”.

2. The fire alarm control panel shall provide internal system diagnostics and maintenance user interface controls to display and/or report the power, communications, and general status of specific panel components, detectors, and modules. The fire alarm control panel shall provide device loop controller diagnostics to identify common alarm, trouble, ground fault, and Class A fault conditions.
3. The fire alarm control panel shall allow the user to display/report the condition of the analog/addressable detectors, with analog sensitivity reading, and shall allow the user to report history for alarm, supervisory, monitor, trouble ad restore activity on the system, with time date stamp.
4. The fire alarm control panel shall allow the user to disable/enable devices, zones, actions, and sequences. The fire alarm control panel shall allow the user to activate/restore outputs, actions, and sequences. The fire alarm control panel shall allow the user to service the time and date of the system, and to change passwords for users. All these features shall be password protected.
5. The fire alarm system shall be programmed to District standards for specific general alarm functions, and other common operating functions, as defined by the District’s Fire Alarm Maintenance Group. Failure to follow District standards shall be considered cause to reprogram the system to District standards, at contractor’s expense. All panels will include a separate general alarm, NAC, HVAC\damper, Door Holder, Sprinkler and Elevator disable function. Fire Drill\Dialer disable function shall not be allowed.

2.3 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

A. Alarm Sequence of Operation: Operation of any alarm initiating devices shall automatically:

1. Sound local audible signal and display red common alarm LED.
2. Sound audible notification appliances throughout the building.
3. Flash visual notification appliances throughout the building.
4. Sound/flash the exterior Fire Dept. Response Point horn/strobes.
5. Indicate the device in alarm on the fire alarm control panel and remote annunciator.
6. Indicate the location of alarm zone (floor and area) on fire alarm control panel and remote annunciator.
7. Alarm signal transmitted to District central stating receiver.
8. Alarm signal transmitted to e-mail list
9. Manual acknowledgement function at the fire alarm control panel silences local audible alarm. Visual alarm condition is displayed until alarm condition is restored and panel is reset.

B. Duct Smoke Detector Sequence of Operation: Operation of any duct smoke detector shall automatically:

1. Sound local audible signal and display yellow common supervisory LED.
2. Indicate the device in supervisory on the fire alarm control panel and remote annunciator.
3. Indicate the location of supervisory zone (floor and area) on the fire alarm control panel and remote annunciator.
4. Supervisory signal transmitted to District central station receiver.
5. Shutdown all HVAC unit(s) associated with the duct smoke detector zone, as required by the AHJ.
6. Delay for 60 seconds then close smoke/fire damper(s) associated with the specific HVAC system ductwork, as required by the AHJ. On reset allow 60 second delay of HVAC unit for dampers to open first.
7. A manual acknowledge function at the fire alarm control panel silences local audible alarm. Visual supervisory condition is displayed until supervisory condition is restored.

C. Trouble Sequence of Operation: The entire fire alarm system wiring shall be electrically supervised to automatically detect and report trouble conditions to the fire alarm panel. Any opens, grounds, disarrangement of system wiring on alarm initiating circuits, opens, shorts, grounds, or disarrangement of system wiring on alarm notification appliance circuits, or device trouble or maintenance conditions, shall automatically:

1. Sound local audible signal and display yellow common trouble LED.
2. Indicate the device in trouble on the fire alarm control panel and remote annunciator.
3. Indicate the location of trouble condition, as applicable, on the fire alarm annunciator.
4. Trouble signal transmitted to District central station receiver.
5. Manual acknowledgement function at the fire alarm control panel silences local audible signal. Visual trouble condition is displayed until the trouble condition is restored.

D. Alarm Reset: System remains in alarm mode until alarm condition is restored and fire alarm system is manually reset with key-accessible reset function. System resets only if initiating circuits are out of alarm. On reset allow 60 second delayed startup of HVAC unit for dampers to open first.

E. Alarm Silence: System audible and visual notification appliances remain sounding/flashing until the fire alarm system is manually silenced with a key-accessible alarm silence function. Visual notification appliances remain flashing until the fire alarm system is manually reset as described above. System audible and visual notification appliances shall resound/flash upon reactivation of alarm silence function.

F. Drill Switch: Shall not be allowed.

G. Lamp Test: A manual lamp test function causes alarm indication of each alarm, trouble and/or system LED at the fire alarm control panel and remote annunciators upon activation of key-accessible lamp test function. Alarm indication of LEDs shall turn off upon reactivation of lamp test function, or upon automatic timeout.

2.4 ANNUNCIATORS

A. Remote Annunciators

1. Alpha Numeric Annunciators: Remote alpha numeric Annunciators shall be located throughout the facility, as indicated on the plans. The annunciator shall operate from system 24vDC, be battery backed up, and shall contain a supervised, backlit, liquid crystal display (LCD) with a minimum of 4 lines with 20 characters per line. Each annunciator shall be capable of supporting custom messages similar to the main fire alarm control panel display. Provide key-accessible Lexan cover for Main Entry Annunciator location only.

2.5 GRAPHIC DISPLAY MAPS

A. Graphic display maps of the system shall be located at the fire alarm control panel and at all fire alarm annunciator panels, as shown on the plans. The graphic maps shall provide a graphical representation of the building layout with the fire alarm devices and system ID numbering indicated. The maps shall be framed behind clear Lexan glass, and shall be readily modifiable to incorporate future changes in the buildings function.

B. Graphic Maps shall be orientated for user reference based on the location in the building and have a “You Are Here” flag for each location.

C. Graphic maps shall include:

1. Building name and address including zip code (Black, Bold, ½" text)
2. Accurate north arrow based on orientation of each map.
3. Symbol legend identifying each device as shown on graphic map.
4. "You Are Here" arrow indicator (Red, Bold, ¼" text)
5. Room Designations (Black, 1/8" text)
6. Device addresses with preceding zeros, i.e. L01D001 (Blue, 1/8" text)
7. Initiating Devices (Red)
8. Supervisory Devices (Orange)
9. Controlled HVAC units (Black, 1/8" text in hexagon include AHU, RTU or other)
10. Water Shutoff Location (Blue)
11. Gas Shutoff Location (Green)
12. Electrical Shutoff Location (Red)
13. Fire Hydrant Locations (Red)
14. Sprinkler zone map key plan
15. Roof Access Locations

D. For buildings protected by automatic sprinklers, graphic maps shall include a sprinkler zone map indicating areas of the building protected by automatic sprinklers with associated sprinkler zone labels.

2.6 INTELLIGENT ANALOG/ADDRESSABLE INITIATING DEVICES

A. All initiating devices shall be UL Listed for Fire Protective Use.

B. INTELLIGENT DETECTORS GENERAL:

1. The system detectors shall be capable of full digital communications using polling protocol and shall be individually addressable. The detectors shall have a separate means of displaying communication and alarm status. As a minimum, each detector shall have a flashing LED to indicate communications status, and a red LED to indicate alarm status of the detector,
2. Each detector shall be capable of providing pre-alarm and alarm signals in addition to normal, trouble and need for cleaning information. Each detector shall be individually programmed to operate at any one (1) of five (5) sensitivity levels. And shall be capable of being programmed for different sensitivities during day/night periods: which allows the detector to be more sensitive during unoccupied periods, when lower ambient background conditions are expected. Each detector shall be provided with an environmental compensation feature, which will adjust the detector's compensation value to counteract the impacts of temperature, humidity, other contaminates, as well as detector aging. The individual detector's environmental compensation feature shall update itself, as a minimum, once every twenty-four (24) period. The detector shall monitor the environmental compensation value and alert the system operator when the detector approaches 80% and 100% of the allowable environmental compensation value.
3. Ionization smoke detectors shall not be used in District facilities.
4. Where necessary to distinguish the locations of two or more detectors, compass directions shall be incorporated in the device location description in programming.

C. FIRE DETECTION SENSORS

1. Heat Detector, Fixed Temperature/Rate-of-Rise: provide intelligent analog/addressable combination fixed temperature/rate of rise heat detector with a nominal alarm point rating of 135 degrees F, and a rate of raise alarm point of 15 degrees F. The heat detector shall

incorporate a low mass thermistor heat sensor and shall operate at a fixed temperature and at a temperature of the air in its surroundings to minimize thermal lag or wall mount installation. The device location description in programing shall include “R135” for this type of heat detector. The heat detector shall mount to any of the mounting bases as specified below, and shall be suitable for operation in the following environment:

a. Temperature: 32 degrees F to 100 degrees F
b. Humidity: 93% RH, non-condensing
c. Elevation: No limit

2. Heat Detector, Fixed Temperature: Provide intelligent analog/addressable fixed temperature heat detector with a nominal alarm point rating 135 degrees F and 200 degrees F. The heat detector shall incorporate a low mass thermistor heat sensor and operate at a fixed temperature. The heat detector shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to report an alarm condition and shall be rated for ceiling or wall mount installation. The device location description in programing shall include “F” followed by the nominal alarm point rating for each heat detector of this type (F135, F200, etc.) The heat detector shall mount to any of the mounting bases as specified below, and shall be suitable for operating in the following environment:
    a. Temperature: 32 degrees F to 100 degrees F
    b. Humidity 93% RH, non-condensing
    c. Elevation: No limit

D. SMOKE DETECTOR SENSORS

1. Photoelectric Smoke Detector: Provide intelligent analog-addressable photoelectric smoke detector. The photoelectric smoke detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings and shall continually monitor any changes in sensitivity due to the environmental effects of dirt, smoke, temperature, aging and humidity. The photoelectric smoke detector shall be rated for ceiling or wall mount installation, and shall be rated for operation in constant air velocities from 4,000 ft/min. The percent smoke obscuration per foot alarm set point shall be field selectable to any of five (5) sensitivity settings, ranging from 1.0% to 3.5% and shall be suitable for operation in the following environment:
    a. Temperature: 32 degrees F to 100 degrees F
    b. Humidity 93% RH, non-condensing
    c. Elevation: No limit
2. Projected Beam Smoke Detectors: Provide OSID (by Xtralis) type beam detectors, as indicated on the plans. The unit shall be capable of covering distances up to 300 feet, and shall feature automatic gain control, which shall compensate for gradual deterioration from dirt accumulation on lenses. The beam detectors shall be either ceiling mount or wall mount. Provide a key activated remote test switch/annunciator station (if compatible) mounted on ceiling (preferred) or a minimum of 8ft above the finished floor (accessible from a 6’ ladder). Identify the remote test station with the associated device ID number it controls, and the associated beam detector unit identification. Provide a keyed override switch or override selectable button on the FACP to bypass the beam detectors for 4 hours. An active bypass shall annunciate a supervisory condition on the FACP and annunciator panels.
3. Standard Detector Mounting Base with Trim Ring: Provide standard detector mounting base with trim ring suitable for mounting to a standard electrical box or trim ring. The standard detector base shall have the following minimum requirements:
    a. Removal of the respective smoke detector shall not affect communications with the remaining other detectors.
    b. Terminal connections shall be made on the room side of the base.
    c. The base shall be capable of supporting one (1) remote alarm LED indicator, where shown on the drawings.
4. Relay Detector Mounting Base with Trim Ring: Provide relay detector mounting base with trim

ring suitable for mounting to a standard electrical box or trim ring. The relay detector base shall have the following minimum requirements:
    a. Removal of the respective smoke detector shall not affect communications with the remaining other detectors.
    b. Terminal connections shall be made on the room side of the base.
    c. The form "C" dry relay contacts shall have a minimum contact rating of 1 Amp at 30vDC and be listed for "pilot duty."
    d. The operation of the relay shall be controlled from its respective detector and shall automatically de-energize when the detector is removed.
5. Isolator Detector Mounting Base with Trim Ring: Provide isolator detector mounting base with trim ring suitable for mounting to a standard electrical box or trim ring. Isolator devices shall only be used when the SLC leaves the building or enters a wet area. The isolator detector base shall have the following minimum requirements:
    a. Terminal connections shall be made on the room side of the base.
    b. The isolator base shall operate upon a short circuit condition on the device initiating loop circuit.
    c. Following a short circuit condition, each isolator/detector shall be capable of performing an internal self-test procedure to reestablish normal operations.
    d. Isolator device locations shall be shown on the graphic maps.
6. Duct Detector Housing: Provide smoke detector duct housing assemblies to facilitate mounting an intelligent analog/addressable photoelectric smoke detector, with a standard, relay, or isolator mounting base. Protect the measuring chamber from damage and insects and provide an air exhaust tube and an air sampling inlet tube, which extends into the duct air stream, a minimum length of 75% of the duct width being covered. Provide air sampling inlet tube to cover duct widths up to ten (10) feet. The duct detector shall be suitable for use on ductwork with airflow velocities of 300ft^3/min to 4,000 ft^3/min.
    a. Provide key activated remote test station, as shown on the drawings.
    b. Provide duct detector housing with auxiliary relay for all HVAC unit locations, for transmission of the alarm signal to the HVAC unit DDC control panel.
    c. Provide duct detector housing with auxiliary relay for all smoke/fire damper locations and Building Automation interface.
    d. Provide MAGNEHELIC DIFFERENTIAL PRESSURE delta and date of install written on the duct above the detector housing with a BLACK SHARPIE PEN. Also document this value on the permanent Record of Completion.
7. Remote Duct\Beam Detector Test Station: Provide a remote duct detector test station to facilitate testing of intelligent duct smoke detectors programmed actions and sequences. The test station shall be key-operated, shall feature a red alarm LED, and shall mount to a standard electrical box or trim ring. When the key is in the "TEST" position, it shall not be possible to remove the key; the alarm LED shall light to indicate that the duct detector is in alarm, and all programmed functions shall occur. Upon system reset, the "TEST" condition shall clear and the system returns to normal. Mount remote test station in the nearest corridor location in the ceiling tile (preferred), or wall mounted at a minimum height of 8 ft from the finished floor (accessible from 6' ladder). Identify the remote test station with the associated device ID number it controls and the associated HVAC until identification.
8. Provide keyed override switch with four (4) hour timer for gym and auditorium beam detectors. Location to be approved by JCSD and Engineer prior to installation.

E. CARBON MONOXIDE DETECTORS
1. Carbon monoxide (CO) detector shall be an intelligent detector listed to Underwriters Laboratories UL 2075 for Gas and Vapor Detectors and Sensors. The detector shall be equipped with a trouble relay. The detector's base shall be able to mount to an approved electrical box or direct (surface) mount to the wall or ceiling. The detector shall provide dual-color LED indication that blinks to indicate normal standby, alarm, or end-of-life. The detector shall provide this with a test mode that accepts CO gas from a test agent and alarms immediately upon sensing CO entry.

2.7 INTELLIGENT MODULES – GENERAL

A. The system modules shall be capable of full digital communications using polling protocol and shall be individually addressable. The modules shall have a separate means of displaying communication and alarm status. As a minimum, each module shall have a flashing LED to indicate communications status, and a red LED to indicate alarm or active control status of the module. The modules input and output circuit wiring shall be supervised for opens and grounds faults, and shall be suitable for operation in the following environment:

1. Temperature: 32 degrees F to 100 degrees F
2. Humidity 93% RH, non-condensing
3. Elevation: No limit
4. Do not mount intelligent modules above finished ceilings. The intelligent monitor and control modules shall be mounted so that the LED is visible.
    a. Simplex modules must have Simplex listed cover plate to allow view of LED.
    b. Notifier Mini-modules are not allowed
    c. Dual modules are not allowed.
5. Multi-input modules shall not be acceptable unless each input has a distinguishable color or pulse.
6. Bi-directional amplification (if provided) shall be monitored for loss of power, antenna failure, loss of radio signal, battery charger fail, and low battery.

B. FIRE ALARM INITIATING DEVICES

1. Intelligent modules must be mounted at a height accessible from a 6’ ladder from a finished floor.
2. Single Input Module:
    a. Provide intelligent addressable single input module, as applicable. The input module shall mount to a standard electrical box or trim ring, and shall provide one (1) supervised Class B circuit, capable of supporting the following circuit types:
        i. Normally Open Alarm Latching (Manual Stations, Heat Detectors, etc.)
        ii. Normally Open Active Non-Latching (Monitors, Fans, Dampers, Doors, Tamper Switches, etc.)
        iii. Normally Open Active Latching (Supervisory, Duct Detectors, etc.)
3. Single Input Signal Module: Provide intelligent addressable single input signal module. The signal module shall mount to a standard electrical box or trim ring, and shall provide one (1) supervised Class B output circuit, capable of supporting the following circuit types:
    a. Audible Indicating Appliance Circuit, polarized, rated at 24vDC at 2 Amps.
    b. Visual Indicating Appliance Circuit, polarized, rated at 24vDC at 2 Amps.
    c. Supervised Control Circuit, polarized, rated at 24vDC at 2 Amps.
4. Control Relay Module: Provide intelligent addressable control relay module. The control module shall mount to a standard electrical box or trim ring and shall provide one (1) Form “C” dry relay contact, rated at 2 Amps at 24vDC or 0.5 Amps at 120vDC; to control external appliances or equipment shutdown. The control relay module shall be rated for “pilot duty” and releasing systems.
5. Fault Isolation Module: Provide intelligent fault isolation module whenever the SLC leaves the building or enters a wet area. The fault isolation module shall mount to a standard electrical box or trim ring and shall be capable of isolating and removing a fault. Isolation devices shall not be installed above ceilings. Device locations shall be documented on the fire alarms graphic maps.

2.8 FIRE ALARM INTEGRATED AUDIO/VISUAL EVACUATION SYSTEMS

A. All notification appliances shall be UL Listed for Fire Protective Service.

B. All visual notification appliances (strobes) or combination appliances with strobes shall be capable of providing the “Equivalent Facilitation” allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADAAG), and shall be UL 1971 listed.

C. Strobes: Provide standard synchronized UL 1971, 24vDC white strobe unit with 15cd, 30cd, 60cd, 75cd, 95cd, or 115cd flash outputs, as shown on the contract documents. The strobes shall have their lens markings oriented for wall mounting or ceiling mounting, shall be provided with screw terminals for wiring interconnect, and shall mount to a standard electrical box or trim ring. Strobes shall bear “ALERT” demarcation on the cover of the unit. Provide weatherproof wall box for outdoor mounting. Locate strobes per NFPA 72 and ADA guidelines.

D. HORNS & COMBINATION HORN/STROBES

1. Horns/Horn Strobes: Provide 24vDC, red electronic horn, with a selectable low or high dBA output, capable of producing a sound rating of 97dBA, and shall have a selectable steady or temporal output. Both selectable features shall be capable of being reversed. Horns that cannot reverse these selectable settings shall not be acceptable. The horn and horn/strobes shall be provided with screw terminals for wiring interconnect and shall mount to a standard electrical box or trim ring. Provide integral, 24vDC.
2. Synchronized UL 1971 strobe unit with 15cd, 30cd, 60cd, 75cd, 95cd, 110cd, or 115cd flash outputs, as shown on the contract documents. The horn/strobes shall have their lens markings oriented for wall mounting or ceiling mounting. Provide weatherproof device and back box, where required. Locate horns and horn/strobes per NFPA 72 and ADA guidelines.

E. FIRE ALARM PULL STATIONS

1. Intelligent Manual Station: Provide intelligent addressable manual station. The manual station shall be semi-flush mounted, non-coded, dual action type, shall be red in color, and shall be individually addressable. The manual station shall require a key to reset the station and shall mount a standard electrical box or trim ring.

2.9 ANCILLARY DEVICES

A. Remote Relays: provide remote control relays connected to supervised ancillary circuits for control of HVAC units, smoke/fire dampers, door releases, elevator controls, and other uses. Relay coils shall have a diode across its coil for polarity reversal purposes and SPDT contacts rated at 10 Amps at 120vAC. Provide load suppression devices, as required. Provide metal enclosure, as required.

B. Heavy Duty Remote Relays: Provide remote control relays connected to supervised ancillary circuits for control of HVAC units, smoke/fire dampers, door releases, elevator controls, and other uses. Relay coils shall have a diode across its coil for polarity reversal purposes and SPDT contacts rated for its interconnected load. Provide load suppression devices, as required. Provide metal enclosure, as required.

C. Magnetic Door Holders: Provide 24VDC magnetic door hardware as shown on the floor plans. Connect all existing magnetic door hardware to a new, dedicated remote power supply. Magnetic door hardware shall be capable of 120VAC or 24VDC power and shall have at least 40 pounds of holding power. Magnet shall be protected against transient surges up to 600 volts. Floor and wall mount models shall be available as well as surface and flush mounting options. Refer to Part 3.1 K for outlet box mounting.

D. Protective Device Wire Guards: Device wire guards shall be UL Listed with specific fire alarm device type and installation application.

1. Wire guards shall be installed on all gym, locker room and cafeteria initiating devices and notification appliances.
2. Contractor shall reuse/reinstall existing UL listed pull station covers.
3. Protective pull station covers equipped with alarms shall be installed without batteries unless otherwise noted on plans or in writing by the engineer or District Project Manager.

2.10 FIRE ALARM WIRE AND CABLE

A. Fire Alarm Power Branch Circuits: Building wire as specified in Section 26 05 19.

B. Fire Alarm Initiating Device Loop (SLC) Circuits and Notification Appliance (NAC) Circuits: as specified in Section 28 05 00.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install manual station with operating handle at 48 inches above finished floor.

C. Install audible and audible/visual notification devices to achieve Code required sound levels as defined in NFPA and ADA Guidelines.

D. Install ceiling mounted visual and audible/visual notification appliances in the center of the space as much as possible, but do not exceed 5 feet in any direction from the center, unless approved by the Engineer, District, or AHJ, prior to rough or installation.

E. Audible/visual notification appliances shall be wall mounted in all common corridors and other areas where ceiling mounted devices are not practical.

F. Ceiling mount visual notification appliances (in rooms/areas open to structure) shall be located at or below lighting level.

G. Install wall mounted visual and audible/visual notification appliances with the bottom of the visual (strobe) lens at 80" above finished floor, or with the top of the visual signal (strobe) lens at 6" below the ceiling (for low ceiling areas), whichever is lower.

H. Install ceiling mounted devices located on structural beams and joists with STI-8170 back plate or approved equivalent. Protect accessible back boxes with bell box or back box skirt or approved equivalent.

I. Install wiring with plenum rated cable. Cable routing shall be perpendicular to or parallel to structural building members and shall utilize a metal bridle ring type support system attached to structural building members only. Mounting cable to other building systems (fire protection, electrical conduit, mechanical ductwork, etc.) or running cable in any fashion other than described, is strictly forbidden. For each device, neatly loop four feet of cable and support inside the nearest bridle ring. Route cables such that a minimum separation of ½" is maintained between Class 1 wire and power-limited fire alarm circuits. Provide separate relay (MR101C or approved equivalent) where 120VAC is required to release fire/smoke dampers, magnetic door holders, or similar. For Notifier devices, barrier CB500 may be installed in place of an additional

relay. See paragraph 3.2 below.

1. For specific limited applications, the visual and audible/visual notification appliances may be installed with the top of the visual signal (strobe) lens at up to 96" above finished floor. Each location must be approved in writing by the Engineer, District, or AHJ, prior to rough-in or installation.
2. For specific limited applications, the visual and audible/visual notification appliances may be wall mounted, when no suitable ceiling mount location is available. Each location must be approved in writing by the Engineer, District, or AHJ, prior to rough-in or installation.

J. Provide panel breaker locks for all electrical circuits for fire alarm and detection control equipment panels. Fire alarm and detection circuit breaker locks shall be color coded red. Breaker Locks shall be Garvin Item # UBL1-RED.

K. Provide and install UL listed surge suppressor on 120VAC at the source for fire alarm control units, remote power supplies, amplifiers, and communicators.

L. Mount end-of-line device in box with last device.

M. Mount outlet box for electric door holder to withstand 80 pounds pulling force. Where wall construction is wood or steel frame, utilize Caddy telescopic bracket TSGB16/TSGB24 or approved equivalent.

N. Make conduit and wiring connections to door release devices, duct smoke detectors, smoke/fire dampers, HVAC units, and other applicable devices, furnished under other Sections.

O. Automatic Detector Installation: Conform to NFPA 72.

P. Automatic Duct Detector Installation: Conform to IMC. When patching ducts, utilize steel plates secured by #8 x ½" indented slotted hex washer head type A sheet metal screws and apply mastic which is listed and labeled "181A-M" in accordance with UL 181A. Do not use tape.

Q. Label each device as specified in Section 28 05 00.

R. Fire alarm contractor shall provide up to five (5) fire alarm system programming downloads in his base bid price, to accommodate the required phasing for the project. Fire alarm contractor shall furnish a unit price for one (1) lot of system programming and download for additional system downloads as part of his bid.

S. Maintain supervision of existing sprinkler system at all times. Coordinate transfer with JCSD and engineer of record in writing.

3.2 FIRE ALARM WIRE AND CABLE COLOR CODE

A. Provide fire alarm circuit conductors with insulation color coded as specified in Section 28 05 00.

3.3 FIELD QUALITY CONTROL

A. Test in accordance with NFPA 72, District, State, and Authority Having Jurisdiction (AHJ) fire department requirements. Use District forms for record of completion.

B. Provide forty-eight (48) hours prior notice to the Engineer and District personnel for rough Inspection, prior to installing ceiling tiles or drywall.

C. Provide seven (7) day prior notice to the Engineer and District personnel for scheduled contractor pre-testing of the system.

D. Provide three (3) day prior notice to the Engineer and District personnel for the scheduled Authority Having Jurisdiction (AHJ) testing of the system.

E. Provide three (3) original copies of the District Certificate of Completion Form. One for the District, one for the Authority Having Jurisdiction (AHJ), and one for the facility's Fire Alarm System Logbook. Utilize the standard District form available on the District website

F. Provide two (2) detailed records of the pre-testing of the system: One for the District and one for the facility's Fire Alarm System logbook. Pre-testing record must contain a minimum of the device ID, proper annunciator description, proper functionality of the device (audible/visual notification, HVAC shutdown, etc.), and date of the testing. Records must be typed in numerical order by device address and include a report generated by the fire alarm control panel. Utilize the standard District form available on the District website. Pre-testing records shall be included as part of the Record of Completion.

G. Decibel levels in every room shall be documented on the record drawings. Any rooms exceeding 95dB as measured per NFPA 72 shall be adjusted by the contractor.

H. Provide voltage drop readings for all notification circuits on battery backup.

I. Contractor to provide ear protection for occupants during fire alarm testing.

3.4 MANUFACTURER'S FIELD SERVICES

A. Prepare and start systems.

B. Include services of factory trained and certified technician to supervise installation adjustments, final connections, and system testing.

C. Provide two (2) hard copies and two (2) electronic copies in CD or flash drive format of the final system programming. One set to be delivered to the District Project Manager for the District Central Reporting System (Building Automation) programming, and one set to be left inside the facility's Fire Alarm System logbook.

3.5 DEMONSTRATION

A. Demonstrate normal and abnormal modes of operation and required responses to each.

3.6 TRAINING

A. Provide the services of a factory certified service representative to demonstrate the system and train Owner's maintenance personnel as specified below.

1. On-Site Training: Provide a minimum of two (2) hours of onsite training of the facility's school staff and Maintenance personal in the basic operations and functionality of the fire alarm system panel, annunciator, and field devices. Review field panel locations, typical device locations, and 120vAC power locations (panels, breakers, and circuits). Demonstrate the various system responses to the field off-normal conditions. Simulate alarm conditions, supervisory conditions, security conditions, trouble conditions, and ground fault conditions of the various field devices. Demonstrate how to reset various building systems (HVAC units,

fire doors, security gates, etc.). Provide written instructions of basic system operating instructions behind clear Lexan framed glass, located adjacent to the fire alarm control panel. DO NOT EVER TRAIN SCHOOL STAFF ON HOW TO DISABLE ANY POINTS.

2. Offsite Training: Provide a minimum of eight (8) hours of offsite training of the District's maintenance personnel in the procedures involved in operating, trouble shooting, servicing, programming, and preventive maintenance of the system. The offsite training shall be conducted in a classroom type setting, and programming manuals of the various components of the system. Provide a working (panel and field devices) system demonstration unit; whereby the various system troubleshooting and servicing procedures can be adequately performed in a "hands-on" scenario. This is per project and can acuminate training time from several projects to allow more detailed instruction.

B. Onsite System training shall be completed within six (6) days of completion of the system and Authority Having Jurisdiction (AHJ) test. Offsite System training shall be completed within thirty (30) days of completion of the system and Authority Having Jurisdiction (AHJ) test, unless the District specifically directs an alternate training schedule.

C. Schedule the onsite training with the District at least three (3) days in advance. Schedule the offsite training with the District at least fourteen (14) days in advance.

3.7 FILE FORMATTING

A. Format the UDACT points list as requested by owner.
B. Example Formatting:

Zone	Description		Item	Address	Type
Zone	Served Area/Physical Location	Physical Location (Blank if physical location is in previous column	Smoke/ Heat/ Flow/ Tamper/ CO/ etc.	Address	Supervisory/ Fire Alarm
1	Vestibule 104		Smoke (Photo)	N1L1D2	Fire Alarm
2	Elevator Lobby 105	North	Smoke (Photo)	N1L1D3	Fire Alarm
3	Clinic 103H		Smoke (Photo)	N1L1D4	Fire Alarm
4	ACU-7 Supply	Corr. 103	Sup L (Duct P)	N1L1D5	Supervisory
5	Elevator Mach. Rm. 105A		Heat	N1L1D6	Fire Alarm

Number	Description	Code	Phone llst
1	Power Supply in MDF (N0L1M1)	FRB	Trouble
2	STOR 116 - Smoke (N0L1D2)	FIR	Alarm
4	GYM 120 N.E. - Smoke (N0L1D4)	FIR	Alarm
5	GYM 120 S.E. - Smoke (N0L1D5)	FIR	Alarm
60	GYM SUPPLY - Supervisory (N0L1D62)	SUP	Supervisory
65	BOILER 120 - CO (N0L1D78)	SUP	GAS

Fire Alarm Inspection Report
Record of Completion

District Monitoring Center
303-232-8688

Contact: _____ Date: _____
Report To: _____ Business: _____
Address: _____ Location Inspected: _____
Jurisdiction: _____ Inspector: _____
_____ Phone: _____

INSPECTION TYPE

[ ] Record of Completion [ ] 22 Month Inspection [ ] 11 Month Inspection
[ ] [ ] [ ] Other (Specify):

DACT Type SYSTEM INFORMATION FACP Type

[ ] Stand Alone Dialer (verify all signal types at Dispatch Center)
[ ] Contact ID (verify all signal types at Dispatch Center)
[ ] LAN Card Installed and tested IP Address
[ ] Other (Specify)
DACT Account Number:
DACT Test Time:
DACT Primary Phone #

Manufacturer:
Model #:
Circuit Styles:
Number of Circuits:
Software Rev:
Recovery Flash Drive in Panel [ ] YES [ ] NO
Device List in Panel [ ] YES [ ] NO

ALARM INITIATING DEVICES AND CIRCUIT INFORMATION

# of	Circuit style	Description
		Manual Stations
		Ion Detectors
		Photo Detectors
		Duct Detectors
		Heat Detectors
		Water Flow
		Supervisory Tamper
		Supervisory DACT

ALARM NOTIFICATION APPLIANCES CIRCUITS

# of	Circuit Style	Description
		Horns
		Strobes
		Horns/Strobes
		Other: (Specify):
# of Alarm Indicating Circuits		
Are Circuits Supervised		[ ] YES [ ] NO
All Circuits tested for silence Function		[ ] YES [ ] NO
Water Flow Horn/Strobe Slaved to flow		[ ] YES [ ] NO

SUPERVISORY SIGNAL-INITIATING DEVICES AND CIRCUIT

# of	Circuit	Description
		Fire Pump Power
		Fire Pump Running
		Fire Pump Auto
		Fire Pump\Controller Trouble
		Generator in Auto Position
		Generator or Controller Trouble
		Switch Transfer
		Generator Engine Running

ANNUNCIATOR FUNCTIONAL TEST

Quantity and style (See NFPA 72, Table 3-6) of signaling line circuits connected to system	
Function Buttons disabled	[ ] YES [ ] NO
Power is non-resettable	[ ] YES [ ] NO
Data is Class A labeled Yellow	[ ] YES [ ] NO
All Lights function	[ ] YES [ ] NO
Back Lights function	[ ] YES [ ] NO
Graphic map is in place	[ ] YES [ ] NO
Verify Alarm and Trouble functions	[ ] YES [ ] NO
Knox box installed (6' 5" AFF)	[ ] YES [ ] NO
Knox Box keys and 3 badges update	[ ] YES [ ] NO
Response Point Horn/Strobe function	[ ] YES [ ] NO

PRIOR TO ANY TESTING

Notifications are made:	Yes	No	Who	Time
District Monitoring Center	[ ]	[ ]		
Building Occupants	[ ]	[ ]		
Building Management	[ ]	[ ]		
Other (Specify)	[ ]	[ ]		
AHJ (Notified of any impairments)	[ ]	[ ]		

FIRE ALARM CONTROL PANEL

FACP Location: _____

	Visual Pass / Fail		Functional Pass/ Fail		Comments
Control Panel					
Primary Power Supply					
Trouble Signals					
Lamps/LEDs					
Fuses					
Secondary Power Supply					

PRIMARY (Main): Nominal voltage

Over current Protection: Type _____ Amps _____

Location: _____

Panel Number & Breaker: _____

Dedicated Circuit Y ☐ N ☐ Secured Breaker Y ☐ N ☐

Web Interface Card IP Address: Comments

Bosch IP Address:

TROUBLE SIGNALS

Ring Back Feature Pass ☐ Fail ☐ N/A ☐ _____

Disconnect Switches Pass ☐ Fail ☐ N/A ☐ _____

Other Switches Pass ☐ Fail ☐ N/A ☐ _____

Ground-fault Each Conductor Pass ☐ Fail ☐ N/A ☐ _____

SECONDARY (Standby):

Type of Battery _____

Visual Inspection Battery #1 _____ Battery # 2 _____

Installation Date Battery #1 _____ Battery # 2 _____

Volts/Amp-Hr. Rating Battery #1 _____ V _____ AHr Battery #2 _____ V _____ AHr

Metered ***Standby*** Current: _____ Amps

Metered ***Alarm*** Current: _____ Amps

Charger Voltage _____ Volts

24 Hour Load Test Voltage _____ VDC Pass ☐ Fail ☐ Comments _____

LAMPS/LEDs Comments

Check all LEDs for Illumination Pass ☐ Fail ☐ N/A ☐ _____

FUSES Comments

Remove all fuses check rating Pass ☐ Fail ☐ N/A ☐ _____

Check all fuses for supervisory Pass ☐ Fail ☐ N/A ☐ _____

Emergency or standby systems used as a backup to primary power supply instead of using a secondary power supply:

[ ] Emergency system described in NFPA 70, Article 700

[ ] Legally required standby described in NFPA 70, Article 701

[ ] Optional standby system described in NFPA 70, Article 702, which also meets performance requirements of Article 700/701

INITIATION & NOTIFICATION DEVICES TOTALS (MAIN FACP)

	DEVICE TYPE	Total # of Devices	Total # Tested	Visual Pass / Fail		Functional Pass / Fail				Comments
	Photo									
	Ion									
	Heat									
	Duct									
	Pull Stations									
	Horn Strobe									
	Horn									
	Strobe									
	Outside H/S									

NOTIFICATION DEVICES (MAIN FACP)

CIRCUIT	STYLE	Total # of Devices	Total # Tested	Visual Pass / Fail		Functional Pass / Fail		Circuit Rating Amps	Circuit Amps.	EOL True measured Voltage

COMMUNICATOR CONTROL PANEL

Manufacturer: _____

Model: _____

	Visual Pass / Fail		Functional Pass/ Fail		Comments
Control Panel					
Primary Power Supply					
Trouble Signals					
Lamps/LEDs					

Fuses					
Secondary Power Supply					

PRIMARY (Main): Nominal voltage _____

Overcurrent Protection: Type _____ Amps _____

Location: _____

Panel Number & Breaker: _____

Dedicated Circuit Y ☐ N ☐ Secured Breaker Y ☐ N ☐

TROUBLE SIGNALS				Comments
Power Disconnect Switches	Pass ☐	Fail ☐	N/A ☐	
Other Switches	Pass ☐	Fail ☐	N/A ☐	
Ground-fault Each Conductor	Pass ☐	Fail ☐	N/A ☐	

LAMPS/LEDs				Comments
Check all LEDs for Illumination	Pass ☐	Fail ☐	N/A ☐	

FUSES				Comments
Remove all fuses check rating	Pass ☐	Fail ☐	N/A ☐	
Check all fuses for supervisory	Pass ☐	Fail ☐	N/A ☐	

SECONDARY (Standby):
Type of Battery _____

Visual Inspection Battery #1 _____ Battery # 2 _____
Installation Date Battery #2 _____ Battery # 2 _____
Volts/Amp-Hr. Rating Battery #1 _____ V _____ Ahr Battery # 2 _____ V _____ Amps
Metered ***Standby*** Current: _____ Amps
Metered ***Alarm*** Current: _____ Amps
Charger Voltage _____ Volts

24 Hour Load Test Voltage _____ VDC Pass ☐ Fail ☐ Comments _____

Two Different Digital Alarm Communicator Receiver Telephone Numbers Programmed Into the Digital Alarm Communicator Transmitter. (DACT) Yes ☐ No ☐

Signal	**Yes**	***No***	***N/A***	***Comments***
Alarm Received in 90 Sec.	☐	☐	☐	
Alarm Restore	☐	☐	☐	
Trouble Received in 90 Sec.	☐	☐	☐	
Trouble Restore	☐	☐	☐	
Supervisory	☐	☐	☐	
AC Loss	☐	☐	☐	
AC Restore	☐	☐	☐	

Low Battery	☐	☐	☐	
Low Battery Restore	☐	☐	☐	
Primary Phone Line Loss	☐	☐	☐	
Primary Phone Line Loss Restore	☐	☐	☐	
Secondary Phone Line Loss	☐	☐	☐	
Secondary Phone Line Loss Restore	☐	☐	☐	
Building Automation Response To Alarm	☐	☐	☐	
Building Automation Response To Trouble	☐	☐	☐	

VERIFY DACT PHONE NUMBERS	# 1
	# 2

AUXILIARY POWER SUPPLY

(Use one form for each panel)

Power Supply Name _____

Power Supply Location _____

Power Supply Control _____

	Visual Pass / Fail		Functional Pass/ Fail		Comments
Control Panel					
Primary Power Supply					
Trouble Signals					
Lamps/LEDs					
Fuses					
Secondary Power Supply					

PRIMARY (Main): Nominal voltage _____

Over current Protection: Type _____ Amps _____

Location: _____

Panel Number & Breaker: _____

Dedicated Circuit Y [ ] N [ ] Secured Breaker Y [ ] N [ ]

TROUBLE SIGNALS				Comments
Ring Back Feature	Pass [ ]	Fail [ ]	N/A [ ]	
Disconnect Switches	Pass [ ]	Fail [ ]	N/A [ ]	
Other Switches	Pass [ ]	Fail [ ]	N/A [ ]	
Ground-fault Each Conductor	Pass [ ]	Fail [ ]	N/A [ ]	

LAMPS/LEDs				Comments
Check all LEDs for Illumination	Pass [ ]	Fail [ ]	N/A [ ]	

FUSES				Comments
Remove all fuses check rating	Pass [ ]	Fail [ ]	N/A [ ]	
Check all fuses for supervisory	Pass [ ]	Fail [ ]	N/A [ ]	

SECONDARY (Standby):

Type of Battery _____

Visual Inspection Battery #1 _____ Battery # 2 _____

Installation Date Battery #2 _____ Battery # 2 _____

Volts/Amp-Hr. Rating Battery #1 ____ V ____ AHr Battery # 2 ____ V ____ AHr

Metered ***Standby*** Current: _____ Amps

Metered ***Alarm*** Current: _____ Amps

Charger Voltage _____ Volts Comments

24 Hour Load Test Voltage _____ Volts Pass [ ] Fail [ ] _____

NOTIFICATION DEVICES

CIRCUIT	STYLE	Total # of Devices	Total # Tested	Visual Pass / Fail	Functional Pass / Fail	Circuit Rating Amps	Circuit Amps.	EOL True measured Voltage

COMMENTS:

Recommendations:

Items in need of Immediate Action:

Testing team must use ***Jeffco Schools Alarm Pre-testing and Device Report.XLS*** for inspection and testing of each device.

Notification That Testing is Complete	Yes	No	Who	Time
District Dispatch Center (303-232-8688)	[ ]	[ ]		
Building Occupants	[ ]	[ ]		
Building Management	[ ]	[ ]		
Other (Specify)	[ ]	[ ]		
AHJ (Notified of any impairments Cleared)	[ ]	[ ]		

The Following Did Not Operate Correctly:

System Restored to Normal Operation: **Date:** **Time:**

Recommendations:

Items in need of Immediate Action:

Inspector certifies that this system test and inspection has been performed in accordance with all NFPA standards

Name of Inspector: **Date:** **Time:**

Signature:

Name of Owner or Representative:

Date: **Time:**

Signature:

PRINT THIS SECTION FOR PRE-TESTING REPORT										
			Visual Inspection							
Address	Description	%	Location	Label	Ring	Dirty	Other	Functional	Pass	Fail
			OK	OK	OK			OK	X	

END OF SECTION

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SECTION 28 46 50

FIRE ALARM VOICE EVACUATION SYSTEM

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the Contract Documents, including the General and Supplementary General Conditions, and Division 1 General Requirements shall apply to work of this Section.

B. Fire Alarm manufacturer shall be required to provide Jefferson County Public Schools a licensed copy of any software required to download, modify and maintain the system. Programming access codes shall not be given to the District until after the warranty period.

1.2 SCOPE

A. The work covered by this Section of the Specification shall include all labor, equipment, materials, and services to furnish and install a complete emergency communication system of the zoned, non-coded general alarm type. It shall be complete with all necessary hardware, software, and memory specifically tailored for this installation. The system shall consist of, but not be limited to, the following:

1. Digital Voice Command
2. Digital amplifiers
3. Local paging microphone
4. Access control interface
5. Gymnasium sound system interface
6. Auditorium sound system and lighting interface
7. Indoor selectable output speaker strobes and dual voltage evacuation speakers
8. Outdoor Selectable output loudspeakers.

1.3 RELATED SECTIONS

A. Section 07 80 00: Fire and Smoke Protection

B. Section 08 71 00: Door Hardware

C. Section 21 13 13: Wet Pipe Sprinkler Systems

D. Section 23 33 00: Air Duct Accessories

E. Section 26 05 00: Common Work Results for Electrical Systems

F. Section 26 05 19: Low Voltage Electrical Power Conductors and Cables

G. Section 26 05 26: Grounding and Bonding for Electrical Systems

H. Section 26 05 29: Hangers and Supports for Electrical Systems

I. Section 26 05 33: Raceways and Boxes for Electrical Systems

J. Section 26 05 53: Identification for Electrical Systems

K. Division 27: Communications

L. Jefferson County School District Technical Details Drawings Volume II

M. Section 28 05 00: Common Work Results for Electronic Life Safety and Security

N. Section 28 46 00: Fire Alarm and Detection Systems

1.4 APPLICABLE CODES AND STANDARDS

A. Materials and workmanship shall conform to the latest issue of all industry standards, publications, or Regulations referenced in this Section, and with the following Codes and Standards, as applicable:

1. All equipment shall be listed and classified by Underwriters Laboratories, under the following standards:
   a. Signaling Systems
   b. UL 464 – Audible Signal Applications
   c. UL 864 – Control Units for Fire Protective Signaling Systems
   d. UL 1480 - Speakers for Fire Alarm and Signaling Systems, Including Accessories
   e. UL 1971 - Standard for Signaling Devices for the Hearing Impaired
   f. NFPA 72 - National Fire Alarm and Signaling Code

B. The vendor shop drawings shall comply with Jefferson County School District (JCSD) Technical Guidelines and Technical Details Drawings - Volume II.

C. The contractor installation shall comply with Jefferson County School District Technical Guidelines and Technical Details Drawings - Volume II.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. The JCSD Fire Alarm System Voice Evacuation Design Criteria shall be used to communicate compliance with NFPA and JCSD standards to the AHJ. Acoustically Distinguishable Spaces and Fire Alarm System Interfaces shall be incorporated into the Plans submitted to Local AHJ's.

B. The design criteria matrix indicating expected dBA levels and CIS scores shall be incorporated into the Plans submitted to Local AHJ's.

C. Speakers shall be set for 25volt operation and adjusted or tapped as follows unless otherwise recommended by the vendor to meet Acoustically Distinguishable Space requirements:

1. Hall speakers: 1 watt
2. Room speakers: 1 watt
3. Bathroom speakers: 0.25 watt
4. Gym speakers: 7 ½ / 2 watts
5. Cafeteria speakers: 2 watts
6. Outside speakers: 7 ½ / 1.8 watts

D. Size amplifiers to accommodate maximum speaker tap settings for each device.

E. Furnish exterior weatherproof strobes with amber lenses at card reader entrances.

1. Mount 10'AFF.
2. Provide permanent placard adjacent to strobe that reads "DO NOT ENTER WHEN FLASHING". Placard background shall match building color with contrasting 6 inch letters.

2.2 FIRE ALARM SYSTEM SEQUENCE OF OPERATION

A. Audible Alarm Notification: By voice evacuation and tone signals on loudspeakers in areas as indicated on drawings.

B. Automatic Voice Evacuation Sequence:

1. The audio alarm signal shall consist of two cycles of the temporal code alarm tone followed by an automatic digital voice message. At the end of the voice message, the alarm tone shall resume. This sequence shall sound continuously until the "Alarm Silence" switch is activated.
2. All audio operations shall be activated by the system software so that any required future changes can be facilitated by authorized personnel without any component rewiring or hardware additions.

C. The voice evacuation system shall a minimum of 16 pre-recorded messages and 8 custom recorded messages to be defined by Jefferson County Public Schools in a format similar to the following:

1. Fire Evacuation:
   Label Identification/Color – "FIRE"/Red
   Alert Tone – Two cycles of the temporal code 3 pattern, then the evacuation message, then two more cycles of the temporal code 3 pattern.
   Message [if available] [female voice] – "Attention, Attention. A fire emergency has been reported in the building. Please leave the building using the nearest exit, immediately."
   NOTE: The temporal code 3 pattern shall only be used for fire evacuation messages.
2. Emergency Evacuation
   Label Identification/Color – "EMERGENCY"/Orange
   Alert Tone – Fast whoop sound is played for 5 seconds. Follow same pattern as above (Tone, tone, message, message, repeat).
   Message [if available] [female voice] – "Emergency Evacuation. An emergency has been reported in the building. Please leave the building using the nearest exit, immediately."
3. Shelter:
   Label Identification/Color – "SHELTER"/Purple
   Alert Tone – 100kHz steady tone is played for 5 seconds.
   Message – "Take shelter."
4. Label Identification/Color – "ALL CLEAR"/Green
   Alert Tone – 3 chimes.
   Message – "May I have your attention please. The emergency has now ended. An "All Clear" has been given. Please resume normal duties. Thank you for your cooperation."
5. Carbon Monoxide
   Label Identification/Color– "CARBON MONOXIDE"/Light Green
   Alert Tone – Two cycles of temporal 4 pattern
   Message [if available] [female voice] – "Carbon Monoxide detected, please evacuate the building, Carbon Monoxide detected, please evacuate the building." Repeat until Silence.
6. Temporal Code dBA test tone –

Label Identification/Color – “TEST TONE”/Brown
Alert Tone – Continuous Temporal Code

D. Paging Interface:

1. Provide a relay to deactivate/shunt the Bogen paging system during an active fire alarm.

E. Gymnasium sound system interface:

1. Provide low level audio interface with the gymnasium sound system during an active fire alarm.

F. Auditorium sound system and lighting interface

1. Provide a relay to activate the auditorium lights during an active fire alarm.
2. Provide low level audio interface with the auditorium sound system during an active fire alarm.

G. Voice Paging

1. The system shall be configured to allow voice paging. Upon activation of any speaker manual control switch, the alarm tone shall be sounded over all speakers in that group.
2. The control panel operator shall be able to make announcements via the push-to-talk paging microphone over the pre-selected speakers.
3. Facility for total building paging shall be accomplished by the means of an "All Call" switch.
4. Paging zones shall be categorized:
    a. By level
    b. Academic (classrooms, hallways, administration, restrooms)
    c. Commons (Gym, Cafeteria, Auditorium, stage)
    d. Exterior
    e. As directed on contract documents

2.3 FIRE ALARM INTEGRATED AUDIO/VISUAL EVACUATION SYSTEMS

A. All notification appliances shall be UL Listed for Fire Protective Service.

B. All visual notification appliances (strobes) or combination appliances with strobes shall be capable of providing the “Equivalent Facilitation” allowed under the Americans with Disabilities Act Accessibilities Guidelines (ADAAG), and shall be UL 1971 listed.

C. Strobes: Provide standard synchronized UL 1971, 24vDC white strobe unit with 15cd, 30cd, 60cd, 75cd, 95cd, 115cd, 135cd, 150, 177 or 185cd flash outputs, as shown on the contract documents. The strobes shall have their lens markings oriented for wall mounting or ceiling mounting, shall be labeled “ALERT”, shall be provided with screw terminals for wiring interconnect, and shall mount to a standard electrical box or trim ring. Provide weatherproof wall box for wet location mounting. Locate strobes per NFPA 72 and ADA guidelines.

D. SPEAKERS & COMBINATION SPEAKER/STROBES

1. Speaker/Speaker Strobes: Provide 25.0 or 70.7 Vrms white UL 1480 speaker approved for fire protective signaling systems., with a selectable low or high dBA output, capable of

producing a sound rating of 97dBA, and shall have a selectable speaker taps for 1/4W, 1/2W, 1W and 2W. Both selectable features shall be capable of being changed. Speakers that cannot modify selectable settings shall not be acceptable. The speakers and speaker/strobes shall be provided with screw terminals for wiring interconnect, and shall mount to a deep electrical box or trim ring. Provide integral, 24vDC.Synchronized UL 1971 strobe unit with 15cd, 30cd, 60cd, 75cd, 95cd, 110cd, or 115cd flash outputs, as shown on the contract documents. Provide weatherproof device and back box, where required.

2. Synchronized UL 1971 strobe unit with 15cd, 30cd, 60cd, 75cd, 95cd, 110cd, or 115cd flash outputs, as shown on the contract documents. The horn/strobes shall have their lens markings oriented for wall mounting or ceiling mounting. Provide weatherproof device and back box, where required. Locate horns and horn/strobes per NFPA 72 and ADA guidelines.

3. The supervised horn loudspeaker shall be a STH-15S/STH-15SR or approved equal. The horn shall be weather resistant and constructed of heavy gauge, treated aluminum. The horn shall be able to operate within any ambient temperature environment ranging from 66 degrees C (150°F) to -35 degrees C (-30°F). The horn shall be a double reentrant type with a 15 watt RMS audio power rated compression driver producing a UL rated 102 dB measured at 15 watts at 10 feet. The horn shall have an impedance selection via a 7 position switch of 5000, 2500, 1300, 666, 333, 89 & 45. Power taps shall be available at 2.0, 4.0, 7.5 & 15 watts for the 100 volt line, .9, 1.8, 3.8, 7.5 & 15 watts for the 70 volt line and .48, .94, 1.8, 7.5 & 15 watts for the 25 volt line. Each power tap shall have a 3dB incremental rating. The frequency response range shall be 400 - 14000 Hz. The horn shall have a dispersion of 70 degrees. The horn assembly shall be furnished with a mounting bracket that allows adjustment on either a vertical or horizontal plane with a single locking pin and include provisions for mounting, banding or strapping. Wiring terminals shall be fully enclosed and a vandal-resistant adapter cover shall provide connection protection for cable or conduit. The horn shall be 7.875” W x 8.75” H x 9.313” D (200 x 222 x 237 mm). The horn shall be finished in gray (STH-15S) or red (STH-15SR) baked epoxy.

4. Speakers, Strobes and Speaker/strobes shall be white and labeled “ALERT”.

E. Voice Alarm: Provide an emergency communication system, integral with the FACP, including voice alarm system components, microphones, amplifiers, and tone generators. Features include:

1. Amplifiers comply with UL 1711, "Amplifiers for Fire Protective Signaling Systems." Amplifiers shall provide an onboard local mode temporal coded horn tone as a default backup tone. Test switches on the amplifier shall be provided to test and observe amplifier backup switchover. Each amplifier shall communicate to the host panel amplifier and NAC circuit voltage and current levels for display on the user interface.

2. Dual alarm channels permit simultaneous transmission of different announcements to different zones automatically or by use of the central control microphone. All announcements are made over dedicated, supervised communication lines. All risers shall support Class B wiring for each audio channel.

3. Emergency voice communication audio controller module shall provide up to 32 minutes of message memory for digitally stored messages. Provide supervised connections for master microphone and up to 5 remote microphones.

4. Status annunciator indicating the status of the various voice alarm speaker zones and the status of fire fighter telephone two-way communication zones.

F. Distributed Module Operation: FACP shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1. Amplifiers, voice and telephone control circuits
2. Addressable Signaling Line Circuits
3. Initiating Device Circuits
4. Notification Appliance Circuits
5. Auxiliary Control Circuits
6. Graphic Annunciator LED/Switch Control Modules

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install audible and audible/visual notification devices to achieve Code required sound levels as defined in NFPA and ADA Guidelines and Intelligibility levels of .8CIS.

C. Install ceiling mounted visual and audible/visual notification appliances in the center of the space as much as possible, but do not exceed 5 feet in any direction from the center, unless approved by the Engineer, District, or AHJ, prior to rough or installation.

D. Audible/visual notification appliances shall be wall mounted in all common corridors and other areas where ceiling mounted devices are not practical.

E. Install wall mounted visual and audible/visual notification appliances with the bottom of the visual (strobe) lens at 80' above finished floor, or with the top of the visual signal (strobe) lens at 6" below the ceiling (for low ceiling areas), whichever is lower.

F. Install ceiling mounted devices located on structural beams and joists with STI-8170 back plate or approved equivalent. Protect accessible back boxes with bell box or back box skirt or approved equivalent.

1. For specific limited applications, the visual and audible/visual notification appliances may be installed with the top of the visual signal (strobe) lens at up to 96" above finished floor. Each location must be approved in writing by the Engineer, District, or AHJ, prior to rough--in or installation.
2. For specific limited applications, the visual and audible/visual notification appliances may be wall mounted, when no suitable ceiling mount location is available. Each location must be approved in writing by the Engineer, District, or AHJ, prior to rough-in or installation.

G. Mount end-of-line device in box with last device.

H. Speaker and strobe circuits shall be paired such that strobe circuit runs will have a respective speaker circuit.

END OF SECTION

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SECTION 31 00 00
EARTHWORK

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, and Division One and other related specification sections apply to work of this section.

1.02 SECTION INCLUDES

A. Clearing, grubbing and site preparation
B. Removal and disposal of debris
C. Handling, storage, transportation, and disposal of excavated material
D. Sheeting, shoring, bracing and protection work
E. Pumping and dewatering as required or necessary
F. Backfilling
G. Construction of fills and embankments
H. Excavation for buildings & structures
I. Pavement Subgrade preparation

1.03 RELATED SECTIONS

A. Section 31 25 00 – Erosion and Sedimentation Controls

B. Section 32 12 00 – Flexible Paving

C. Section 32 13 00 – Rigid Paving
D. AASHTO – American Association of State Highway and Transportation Officials
E. ASTM – American Society for Testing and Materials
   1. C33 – Concrete Aggregates
   2. C136 – Sieve Analysis of Fine and Coarse Aggregates
   3. D698 – Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 5.5 lb. Rammer and 12-Inch Drop
   4. D1241 – Material for Soil Aggregate Subbase, Base and Surface Courses
   5. D1557 – Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort
   6. D4253 – Test Methods for Maximum Index Density of Soils and Unit Weight of Soils Using a Vibratory Table
   7. D4254 – Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
   8. D4318 – Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils
   9. D6938 – Test Method for In-Place Density and Water Content of Soil and Soil Aggregate by Nuclear Methods (Shallow Depth)
F. ACI – American Concrete Institute
   1. 229 – Controlled Low-Strength Materials
G. CABO/ANSI – Council of American Building Officials/American National Standards Institute
   1. A117.1 – Accessible and Useable Buildings and Facilities Standards
H. CDOT – Colorado Department of Transportation
I. OSHA – Occupational Safety and Health Administration
   1. Part 1926 – Safety and Health Regulations for Construction

1.04 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Product Data: Submit on all products or materials supplied herein

C. Test Reports: Indicate supplier, sieve analysis, optimum moisture content and density in accordance with ASTM D698 if appropriate for crushed rock or gravel, pipe embedment and material for fills and embankment

1.05 REGULATORY REQUIREMENTS

A. Burning will not be allowed on-site. Comply with all applicable codes, regulations, and laws.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

C. Obtain and comply with all requirements of Jefferson County and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

D. For public improvements only, in the event of a conflict between municipal standards and this specification, municipal standards for products and installation will govern.

E. Excavation work will be performed in compliance with Jefferson County and current OSHA requirements.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Protect adjacent structures and surrounding areas from damage during excavation, filling, and backfilling

B. Protect work from erosion or other similar types of damage until the project has been accepted. Leave protection in place for subsequent contractors' use.

C. Do not backfill or construct fills during freezing weather. Backfill or construct fills only when temperature is 35°F and rising

D. Do not use frozen materials, snow, or ice in any backfill or fill area

E. Do not backfill or construct fill on frozen surfaces

F. Protect excavated material from becoming frozen

G. Do not backfill or construct fills or embankments during periods of heavy rainfall or precipitation when soil moisture conditions will not allow proper compaction to be achieved

H. Do not remove trees from outside excavation or fill areas unless authorized by the Owner; protect from permanent damage by construction activities

I. Provide temporary bridges for roadways, walkways, driveways, etc.

1.07 QUALITY ASSURANCE

A. All imported material to be free of hazardous and organic wastes, "clean" as defined by EPA, and approved for its intended use by the Owner or project Geotechnical Engineer.

PART 2 PRODUCTS

2.01 MATERIALS

A. General - Soil materials, whether from sources on or off the site must be approved by the Geotechnical Engineer as suitable for intended use and specifically for required location or purpose.

B. Fills and Embankments
   1. To the maximum extent practical use excess earth from onsite excavation for fills and embankments.
   2. Free from rocks or stones larger than 12 inch in greatest dimension and free from brush, stumps, logs, roots, debris, and organic and other deleterious materials
   3. Fill and embankment material must be acceptable to Engineer
   4. No rocks or stones larger than 6 inch in upper 18 inches of fill or embankment. Where allowed, distribute rocks and stones through the fill to not interfere with compaction.

C. Imported Fill for Fills and Embankments:

1. The Contractor is responsible for obtaining additional material for fills and embankments as necessary to meet the requirements shown on the Drawings.
2. Imported fill conforming to the following:
   a. Gradation (percent finer by weight ASTM C136): 3" – 100% passing, No. 4 Sieve – 50-100% passing, and No. 200 Sieve – 35% passing (maximum)
   b. Liquid Limit: 35 (maximum), Plasticity Index: 15 (maximum), Group Index: 10 (maximum)

D. Structural Fill
1. Imported structural fill, such as a ½-inch minus, CDOT Class 7 Aggregate Road Base, conforming to the following:
   a. Gradation: 1" – 100% passing (percent finer by weight ASTM C136), No. 8 Sieve – 20-85% passing, and No. 200 Sieve – 35% (maximum)
   b. Liquid Limit: 30 (maximum), Plasticity Index: 20 (maximum)

E. Topsoil
1. Topsoil is defined as fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of rocks, stumps, stones larger than 2 inches in any dimension, and other extraneous or toxic matter harmful to plant growth for areas to be seeded or planted. Coordinate testing requirements with Landscape Architect and Owner.
2. Clean topsoil free of plants and seeds will be spread to 4-inch minimum depth or as specified by Drawings, whichever is greater.

F. Grubbings
1. Grubbings are defined as the first 1 inch of surface vegetation and topsoil consisting of primarily existing grass groundcover free of roots, brush, and other objectionable material and debris.
2. Reuse grubbing and surface topsoil containing plants and seeds in designated revegetation areas only.

G. Pipe Embedment: Graded gravel
1. Comply with Jefferson County, West Jefferson Metropolitan District,requirements for pipe embedment for public utilities.

2. 1-1/2" Washed rock

Sieve Size (Inch)	Percent Passing by Weight
2"	100
1-1/2"	95-100
1"	80-95
3/4"	30-45
1/2"	10-25
3/8"	<1

3. 3/4" – 1" Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4"	90-100
1/2"	25-60
3/8"	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

4. Well-Graded Sand

Sieve Size	Percent Passing by Weight
3/8"	100

No. 4	95-100
No. 8	80-100
No. 16	50-85
No. 30	25-60
No. 50	10-30
No. 100	10-30
No. 200	2-10

5. Squeegee

Sieve Size	Percent Passing by Weight
3/8”	100
No. 4	85-100
No. 8	30-70
No. 16	5-40
No. 30	0-15
No. 50	0-10
No. 100	0-5
No. 200	<1

H. Compacted Trench Backfill
1. Job excavated material finely divided, free of debris, organic material, and stones larger than 6 inches in greatest dimension without masses of moist, stiff clay, or topsoil
2. In upper 18 inches, no rock or rock excavated detritus, larger than 6 inches except with specific approval from Geotechnical Engineer.
3. No rock greater than 3 inches in greatest dimension within 3 feet of top of pipe

I. Coarse Base Rock
1. Granular material, maximum 3 inches, less than 10% passing 1-inch sieve.
2. Free of trash, clay and dust
3. Compaction as specified by Geotechnical Engineer

J. Road Base
1. Will meet ASTM specification for Class II aggregate base and CDOT Class 6 gradation

Sieve Size	**Percent Passing by Weight**
3/4"	90-100
No. 4	30-65
No. 8	22-55
No. 200	3-12

2.02 ACCESSORIES

A. Controlled Low Strength Material (Flow Fill)
1. Comply with Jefferson County requirements and ACI 229 for the use of flowable fill within the right-of-way or for public utility trench backfill.
2. Product will be a lean, sand-cement slurry, “flowable fill” or similar material with a 28-day unconfined compressive strength between 50 and 200 psi.

B. Non-woven geotextile fabric
1. Needle-punched nonwoven geotextile composed of polypropylene fibers, which are formed into a stable network such that the fibers retain their relative position. Product must be inert to biological degradation and resists naturally encountered chemicals, alkalis, and acids. Product must meet AASHTO M288-06 Class 3 for elongation > 50%.
   a. Mirafi 140N or accepted substitution

PART 3 EXECUTION

3.01 EXAMINATION

A. Field verify the location of all underground utilities, pipelines and structures prior to excavation

3.02 PERFORMANCE — GENERAL

A. Contractor to verify quantities of cuts and fills and perform all earthwork required to meet the grades as shown on the Drawings, including but not limited to, additional import or export required to handle compaction, building and pavement subgrade preparation, and pipe bedding.

B. Perform work in a safe and proper manner with appropriate precautions against hazard

C. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

D. Contain all construction activity on the designated site and within the limits of work. Cost of restoration offsite will be the responsibility of the Contractor

E. Maintain service to pipelines and utilities indicated on Drawings during construction

3.03 PREPARATION

A. Clearing and Grubbing
   1. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris.
   2. Strip subgrade for fills and embankments of surface vegetation, sod, tree stumps and organic topsoil. Strip and stockpile all on-site material meeting the topsoil definition for all areas receiving grading where shown on Drawings
   3. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.
   4. Remove and dispose of tree stumps and roots over 3 inches in diameter to a minimum depth of 18 inches below the natural surface or 5 feet below finished surface level, whichever is lower.
   5. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted
   6. Backfill all excavated depression include grub holes with approved material

B. Preservation of Trees
   1. Do not remove trees outside fill or excavated areas, except as authorized by Engineer
   2. Protect trees and their roots within the drip line that are to remain from permanent damage by construction operation
   3. Trim standing trees in conflict with construction operations as directed by Owner and Landscape Architect

C. Topsoil Stripping
   1. Strip onsite material meeting the topsoil definition to minimum depth of 4 inches from areas to receive grading as shown on Drawings.
   2. Stockpile topsoil in areas designated by Owner and indicated on Drawings where it will not interfere with construction operations and activities and existing facilities
   3. At the completion of work in each area, place and grade topsoil to maintain gradient as indicated and required. Roughen surface as required for erosion control.

D. Waste and Debris
   1. Stockpile all acceptable grubbing for reuse in native revegetation areas
   2. Remove and dispose of all waste materials and debris from clearing, grubbing, stripping and demolition off site

E. Stockpiles
   1. Segregate materials suitable for the following:
      a. Topsoil
      b. Embankments and fills
      c. Backfill

d. Spoils and waste only

2. No excavation will be deposited or stockpiled at any time so as to endanger stability of banks or structures, health of trees and shrubs to be protected, or portions of the Work, either by direct pressure or indirectly by overloading banks contiguous to the operation
3. Stockpile soil materials away from edge of excavations
4. Do not obstruct or prevent access to roads, driveways, ditches, natural drainage channels, and utility control devices
5. If in result of adjacent structures, easement limitations, or other restrictions sufficient storage is not available within Project limits, Contractor will arrange for off-site areas for stockpiling and for moving material to and from the storage area at no additional cost to the Owner

3.04 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations will be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work.

B. Backfill will be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs will be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage will be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, will be borne by the Contractor at no additional expense to the Owner

3.05 TRENCH STABILIZATION

A. Thoroughly compact and consolidate subgrades for concrete structures, precast structures, and utility trench bottoms so they remain firm, dense and intact during required construction activities

B. Remove all mud and muck during excavation

C. Reinforce subgrades with crushed rock or gravel if they become mucky during construction activities

D. Finished elevation of stabilized subgrades are to be at or below subgrade elevations indicated on Drawings

E. Allow no more than ½ inch depth of mud or muck to remain on trench bottoms when pipe bedding material is placed thereon

F. Scarify trench subgrade to a depth of 6 to 8 inches before compaction

3.06 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 0.10 foot

B. Remove existing unsuitable/uncompacted fill, old foundations, rubble/debris, soft or otherwise unsuitable material, and replace with suitable material in excavation

C. Extend excavations to a sufficient distance from structures for placing and removing concrete formwork, installing services and other construction and inspections

D. Trim to neat lines where details call for concrete to be deposited against earth

E. Excavate by hand in areas where space and access will not permit use of machines

F. Provide dewatering and temporary drainage as required to keep excavations dry.

G. Reshape subgrade and wet as required

H. Notify Geotechnical Engineer when structure excavation has reached designated depth. Do not proceed with structure construction until excavation is approved by Geotechnical Engineer.

I. Per the geotechnical report, for overexcavation and recompaction areas at structures, soils will be excavated to a depth of 3 feet below the bottom of all floor slabs. The subexcavation will be configured at a minimum side slope inclination of 1(horizontal):1(vertical) from the toe of the subexcavation slope. The toe of the subexcavation slope will be no closer than 7 feet outside the outermost edge of all concrete footings or building boundaries laterally, whichever is larger. Slope will continue to the proposed surface grades.

3.07 PAVEMENT OVEREXCAVATION AND SUBGRADE PREPARATION

A. Excavate subgrade for asphalt pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.10 foot. Excavate subgrade for concrete pavement areas per the lines, grades, and dimensions indicated on Drawings within a tolerance of plus or minus 0.05 foot.

B. Overexcavate and scarify existing soil as required under pavement areas, slabs, curbs and walks to meet the moisture and compaction specifications herein to depth shown on Drawings.

C. Extend subgrade preparation a minimum of one foot beyond back of proposed pavement, slabs, curbs and walks.

D. Extend subgrade preparation a minimum of two feet beyond back of proposed structure foundation limit.

E. Proof roll with a pneumatic tire equipment with a minimum axle load of 18 kips per axle a maximum of 24 hours prior to paving to locate any soft spots that exhibit instability and deflection beyond subgrade tolerances listed above. Areas that are observed to have soft spots in the subgrade, where deflection is not uniform or is excessive as determined by the Geotechnical Engineer, will be ripped, scarified, dried or wetted as necessary and recompacted to the requirements for density and moisture at the Contractor's expense. After recompaction, these areas will be proof rolled again and all failures again corrected at the Contractor's expense.

F. If the Contractor fails to place the sub base, base course, or initial pavement course within 24 hours or the condition of the subgrade changes due to weather or other conditions, proof rolling and correction will be performed again at the Contractor's expense.

3.08 FILLS AND EMBANKMENTS

A. Using suitable approved materials, shape, trim, and finish cut slopes to conform with contours and elevations indicated on Drawings

B. Suitable materials will consist of excavations or borrow areas
   1. Borrow
      a. Borrow areas will be arranged by Contractor at no additional cost to Owner and will be subject to approval by Geotechnical Engineer
      b. Includes all topsoils and fill materials from approved offsite locations

C. Place in layers from 4 to 8 inches where high degree of compaction is required. Otherwise, place in 8 to 12 inch layers. Will be placed on subgrades approved by Geotechnical Engineer

D. Will not be placed on frozen surface. Do not place snow, ice or frozen materials in fill

E. Level and roll subgrade so surface materials will be compact and bond with the first layer of fill or embankment
   1. Plow and scarify subgrade to a minimum depth of 6 inches until uniform and free of large clods

F. Place in horizontal layers at maximum uncompacted depth per compaction specifications herein.

G. Spread and level material deposited in piles and windrows before compacting

H. Thoroughly compact each layer by rolling or other means acceptable to Geotechnical Engineer to meet the moisture and compaction specifications herein.

I. Alter compaction methods if material fails to meet specified density

J. Where a trench passes through a fill or embankment, place and compact fill or embankment to 12 inch above the top of the pipe before excavating the trench

K. Add water and harrow, disc, blade, or otherwise work each layer to obtain the uniform moisture content and adequate compaction

L. Refer to geotechnical report for additional requirements for fill and embankment preparation requirements.

3.09 COMPACTION

A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations. Place backfill and fill uniformly along the full length of each structure as described herein.

C. Refer to geotechnical report for additional requirements for site development material, subexcavation, compaction and related earthwork operations.

D. Percentage of Maximum Dry Density Requirements: Moisture treat and compact soil to not less than the following percentages of maximum dry density and to within the specified moisture content range of optimum moisture content according to ASTM D698 as follows:

Surface Improvement	Compaction %	Moisture Content
Structures	100%	-2 to +2
Paved Areas	95%	-2 to +2
Utility Trenches	95%	-2 to +2
Lawns or Unpaved Areas	90%	-2 to +2
Public Right-of-way	Per municipal standards	

1. Do not deposit or compact tamped or otherwise mechanically compacted backfill if frozen or if in water.
2. Take particular care to compact backfill which will be beneath slabs, pipes, drives, roads, parking areas, curb, gutters, or other surface construction.

3.010 BORROW OR SPOIL AREA

A. Obtain suitable material required to complete fill and embankments from excavation, on-site areas.

B. The location, size, shape, depth, drainage, and surfacing of borrow or spoil pits will be acceptable to Owner.

C. Make all areas regular in shape with graded and surfaced side and bottom slopes when completed

D. Cut side slopes not steeper than 1:1 and uniform for the entire length of any one side

E. Final grade disturbed areas of borrow to uniform slope (maximum slope = 4:1, minimum slope = 50:1).

F. Use material free of debris and deleterious material

G. Contractor is responsible for compliance with Colorado Discharge Permit System and local erosion control permitting requirements for any and all onsite and offsite, disturbed spoil and borrow areas. Upon completion of spoil and/or borrow operations, clean up spoil and/or borrow areas in a neat and reasonable manner to the satisfaction of the offsite property owner, Owner and Engineer.

3.011 DISPOSAL OF EXCESS EXCAVATED MATERIALS

A. Use excess excavated materials in fills and embankments as indicated on the Drawings to the extent needed. Coordinate with Owner and Engineer on locations for excess material placement.

B. The Contractor is responsible for disposing of all excess excavated materials from the site to a location approved by the Owner or Engineer and permitted with the local authorities.

C. Remove debris, junk, broken concrete, broken asphalt, rock, stones, stumps, logs, roots, and other unsuitable material from the site and dispose of it.

3.012 BLASTING

A. Blasting or other use of explosives is not permitted without Jefferson County approval. Blasting should be performed in accordance with applicable Jefferson County requirements and permits, and other applicable regulator permits.
   1. Contractor to coordinate with geotech report prior to any blasting efforts.

B. General Blasting Requirements
   1. Blast damage behind the trim line will be minimized. Blast damage is defined to include widening and loosening of existing joints or foliation, displacement of rocks and/or creation of new fractures. Utilize the natural geologic bedding planes and joint structure as best practiced and in a predicted and controlled manner to form the final cuts.
   2. Controlled perimeter blasting methods will be used to limit blast damage and overbreak behind the excavation line.
   3. Perimeter drill hole diameters will not exceed 3 inches without Engineer approval. Perimeter drill holes will be drilled such that the vertical tolerance is less than 5 percent of the hole depth up to a maximum horizontal deviation of 6 inches as measured between the hole collar (top) and the hole bottom unless approved by the Engineer unless allowed by the Engineer.
   4. Spacing of perimeter drill holes will not exceed 24-inches unless satisfactory results are demonstrated by test blasts in critical areas unless allowed by the Engineer. In any case, the maximum hole spacing will not exceed 30-inches unless allowed by the Engineer.
   5. Production hole diameters will not exceed 2 ½-inches unless allowed by the Engineer.
   6. Production holes will be denoted in a controlled delay sequence. Production blasting will consist of the main fragmentation blasting resulting from more widely spaced production holes drilled throughout the main excavation area. Production holes will be detonated in a controlled delay sequence. Production blasting will be designed to prevent escape of material beyond the construction limits shown on the Drawings.
   7. Stemming of drill holes will be required to confine any explosive gases, however, explosive gases are not expected at this worksite. High quality angular stemming such as crushed fine gravel will be used. Aggregate produced from drill cutting will not be accepted.
   8. The design of drilling and blasting patterns, explosive types, and quantities will be determined by the Contractor. Control blasting so that ground motion and frequency limitations discussed in “Blasting Requirements” below are met.
   9. The CONTRATOR will be responsible for any damage done to persons, private property, Owner property, the work, existing structures, utilities, other facilities.

C. Blasting Plans
   1. General Blasting Plan: Within 7 days after the Notice of Award, prior to commencing drilling and blasting operations, submit the following information to the Engineer for review and approval:
   2. Names and experience of blasting supervisors: Blasting supervisors will have a minimum of five years of experience in supervising the loading and firing of charges for rock excavation and will have all necessary licenses and permits required by the State and other agencies having jurisdiction.
   3. Methods for and locations of explosives storage.
   4. Methods to be employed for traffic control and other public safety precautions in the use, storage and transportation of explosives.
   5. General methods and approach to blasting which account for the full range of geologic settings and physical conditions present on the project. The approach will describe how the specific blasting

plans will account for various cut geometries, rock types, access problems and required face contours.

6. Method and equipment for the required pre-blast survey and environmental monitoring, and anticipated peak particle velocity level monitoring, structure and appurtenant structures monitoring, and wall monitoring.
7. Equipment intended to be used in or support of blasting operations.
8. Method of containment to prevent rock material from escaping the construction limits, and contingency measures for unanticipated fly rock.
9. Specific Blasting Plan: After the general blasting information is reviewed and approved, and not less than 3 days prior to the drilling of each cut or portion thereof, or at any time the Contractor proposes to change the drilling and blasting methods, submit a “Blasting Plan” to the Engineer for review. The blasting plan will be reviewed by the Engineer and Blasting Consultant before any drilling and blasting work commences. The blasting plan will contain full details of drilling and blasting patterns and controls the Contractor proposes to use for both the controlled and production blasting. All blasting plan submittals and modifications will be approved in writing by the Blasting Consultant in accordance with “Blasting Requirements” below. The blasting plan will contain the following minimum information:
    a. Station limits of proposed shot.
    b. Scale drawings showing plan and section views of all variations of the proposed drill pattern, including clearing limits, free face, burden blasthole spacing, drill hole location, subdrill depths, lift height, blasthole diameters, and blasthole angles.
    c. Loading diagram showing powder factor, type and amount of explosives, primers, initiator, and locations and depths of stemming for all substantial variations within the pattern.
    d. Initiation method and sequence of blastholes, including delay times and delay system.
    e. Manufacturer’s data sheets for all explosives, primers, and initiators to be employed.
    f. Fly rock control measures.
    g. Estimated quantities, measured in cubic yards, of rock in-place, and linear feet of both production and controlled blast drill hole.
    h. Location and attitude of significant fracturing, rock type changes and special circumstances to be accounted for in the plan.
    i. Identification of environmental monitoring method, equipment, and location.
10. Blasting Report: Will be submitted to the Engineer after each blasting operation and prior to any further blasting operations. The report will include the following information:
    a. Blasting Consultant: A Blasting Consultant will be retained by the Contractor to approve the construction blasting design and blasting plans.
    b. A copy of the drilling log information as described above.
    c. Measurements of all production and control holes.
    d. Name of blasting foreman and date and time of blast.
    e. Comments on success of the blast in terms of the specific blasting objectives.
11. Blasting Requirements:
    a. Blasting Consultant: A Blasting Consultant will be retained by the Contractor to approve the construction blasting design and blasting plans.
        i. The Blasting Consultant will be and expert in drilling and blasting of rock slopes and will have at least 5 years of experience in blast design of near-vertical rock cuts and rock slopes. The Blasting Consultant will not be an employee of the explosives manufacturer or explosives distributor.
        ii. The Blasting Consultant will be present during all test blasts, and will sign approval of all proposed blasting plans.
        iii. The qualifications of the Blasting Consultant will be submitted to the Engineer for review, and the selection of the Blasting Consultant will be subject to the approval of the Engineer.
        iv. The Blasting Consultant will also be able to demonstrate a familiarity with geologic principles and practices as applied to blasting and rock excavation.
        v. Prior to establishing a date for the preconstruction conference, submit a resume to the Engineer for the proposed Blasting Consultant which will include education background

related to blasting and detailed resume of experience in the blasting field. A list of at least 3 urban rock blasting projects that demonstrate successfully completed work on which the Blasting Consultant has worked will be part of the information provided. The list will also contain the names and telephone numbers of project Owners with sufficient knowledge of the projects to verify the submitted information.

b. Vibration Specialist: Retain a Vibration Specialist to determine safe vibration limits and locations of seismographs to monitor vibrations.
   i. The Vibration Specialist will be an expert in vibration monitoring of blasts and will have at least 5 years of experience in vibration monitoring of blasts.
   ii. The Vibration Specialist will be approved by the Engineer prior to beginning any drilling and blasting work.
   iii. When it is a possibility that vibration damage to and adjacent structure may occur, monitor each blast with an approved seismograph located between the blast area and the structure of concern. Seismograph locations will be approved by the Blasting Consultant and the Engineer prior to each blast.
   iv. Seismographs will be capable of recording particle velocities for 3 mutually perpendicular components of vibration in the range required for this project and as recommended by the Vibration Specialist.
   v. Perform seismographic monitoring of all blasts to ensure the maximum peak particle velocity with respect structures within 500 feet of the blast area.
   vi. The Vibration Specialist will review all seismograph data after each blast to determine whether particle velocities have exceeded peak particle velocity criteria. Where peak particle velocities have been exceeded, an inspection of the structure to determine possible damage may be required, and this will be performed at the Contractor's expense.
   vii. The Vibration Specialist will submit written documentation to the Engineer summarizing the seismograph data after each blast and prior to performing and additional blasts.
   viii. The following data from each blast will be submitted to the Engineer prior to performing any additional blasts.
      A) Model and manufacturer of each seismograph.
      B) Plan indicating locations of each seismograph.
      C) Type of ground each seismograph was placed on.
      D) Maximum peak particle velocity of each velocity component.
      E) Dated copy of all seismograph data, signed by the Vibration Specialist.

c. Post-blast inspections will be performed upon receipt of a complaint of property damage from the person in charge of the property or if the possibility of damage to structures due to exceeding the maximum peak particle velocity has occurred. These inspections, if required, will be submitted by the CONTRATOR within 7 calendar days of receipt of the complaint or within 7 calendar days of discovery of a blast exceeding the maximum peak particle velocity.

d. Maintain Airblast Control – Airblast monitoring systems will be installed by the Contractor to measure airblast overpressure.
   i. Submit the locations of each airblast monitoring system to the Engineer prior to each blast.
   ii. Equipment specifically designed to measure airblasts will be used.
   iii. Submit records of the peak overpressure measurements to the Engineer after each blast as part of the blasting reports submitted to the Engineer after each blasting operation.

e. Pre-Blast Condition Survey: Perform an initial pre-blast condition survey of nearby existing residential structures, retaining walls and other facilities that may be potentially impacted by the blasting operation at least 14 days before blasting. The survey will extend to all residences surrounding the area of blasting, in addition to residences and structures located within 500 feet of blasting. The survey will be conducted by the Contractor, Jefferson County the Geotechnical Engineer and each property owner. The condition of structures will be documented using photos, descriptions and other means. The Contractor will be required to conduct observations of the properties visited in the pre-condition survey on each day blasting is performed. Crack monitors installed by the Geotechnical Engineering during the precondition survey will read by the Contractor after each day of blasting.

i. A Pre-Blast Condition Survey report for the initial survey and will be submitted to the Engineer and Blasting Consultant at least 7 days prior to the beginning of any drilling and blasting work.
ii. Pre-Blast condition surveys will be conducted at all facilities, walls and structures within 500 feet of the Blast Area of the project.
iii. Contractor will be responsible for any and all damage associated with his blasting activities.

3.013 TRENCH EXCAVATION

A. Establish alignment and grade or elevation from offset stakes provided by the Contractor's surveyor.

B. Excavate trenches so pipes can be laid straight at uniform grade without dips or bumps, between the terminal elevations indicated on the Drawings

C. Comply with pipe specification sections regarding vertical and horizontal alignment and maximum joint deflection

D. Where grades or elevations are not fixed on the Drawings, excavate trenches to provide a minimum depth of backfill cover over the top of pipe as follows. Coordinate depth of cover with utility owners. Increase depth as required by utility owner and at crossings. Minimum depths are:
1. 2.0 feet for drainage piping
2. 2.5 feet for gas piping
3. 2.5 feet for electric, telecom, and fiber optic conduit
4. 2.0 feet for irrigation piping
5. 6.0 feet for sanitary sewer
6. 6.0 feet for water piping
7. Increase depth as required at vertical curves and for clearance beneath existing pipes, conduits, drains, drainage structures, or other obstructions encountered at normal pipe grades

E. Measure pipe cover depth vertically from top of pipe to finished ground or surface elevation

F. Do not open more trench in advance of pipe laying than is necessary to expedite the work; not more than 200 feet

G. Total length of open trench will be limited to 200 feet unless otherwise approved by the Engineer

H. Except where tunneling or boring is indicated on the Drawings, specified, required by jurisdictional agency or permitted by Engineer, excavate trenches by open cut from the surface

I. Limiting trench widths
1. Excavate to a width which will provide adequate working space and pipe clearances for proper pipe installation, jointing, embedment
2. If needed to reduce earth loads to prevent sliding, cut banks back on slopes which extend not lower than 1 foot above the top of the pipe
3. Stipulated minimum clearances are minimum clear distances, not minimum average distances
4. Maximum trench width from six inches above the top of pipe to trench bottom is the pipe outside diameter plus 24 inches
5. Limiting trench widths and permissible clearances from 6 inches above top of pipe to trench bottom for installed pressure and non-pressure piping

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
3	1' 6"	2' 6"
4	1' 6"	2' 6"
6	1' 6"	2' 6"
8	1' 8"	2" 8"
10	2' 0"	3' 0"
12	2' 0"	3' 0"

Pipe Size (inch)	Minimum Trench Width	Maximum Trench Width
16	2’ 8”	3’ 8”
18	3’ 0”	4’ 0”
24	3’ 6”	4’ 6”
36	4’ 6”	5’ 0”

6. If the width of the lower portion of the trench exceeds the maximum permitted, provide special pipe embedment, or concrete encasement as required by loading conditions
7. No excessive trench widths will be allowed to avoid the use of sheeting or shoring and bracing

J. Trench Side Walls
1. Will be sloped, shored, sheeted, braced, or otherwise supported by means of sufficient strength to protect workmen in accordance with applicable rules and regulations established for construction by the federal, state, and local ordinances and regulations
2. Sheet and brace where necessary and as specified herein
3. Excavate without undercutting

K. Trench Bottom
1. Will be thoroughly protected and maintained when suitable natural materials are encountered
2. Will be thoroughly compacted and in approved condition prior to placing gravel bedding, if required
3. Where in earth, trench bottoms for 6 inches and smaller pipe may be excavated below pipe subgrade and granular embedment provided or the trench may be graded to provide uniform and continuous support between bell holes or end joints of the installed pipe at the Contractor's option
4. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material approved by Engineer
5. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined
6. PVC pipe will not be laid directly on trench bottom

L. Mechanical excavation
1. Do not use where its operation would damage buildings, culverts, or other existing property, structures, or utilities above or below ground; hand excavate only in such areas
2. Use mechanical equipment of a type and design which can be operated to provide the following:
   a. Rough trench bottom to a controlled elevation
   b. Uniform trench widths and vertical sidewalls are obtained from 1 foot above the top of the installed pipe to the bottom of the trench
   c. Trench alignment is such that pipe is accurately laid to specified alignment and is centered in the trench with adequate clearance between pipe and trench sidewalls
3. Do not undercut trench sidewalls
4. Recompact trench bottom disturbed by bucket teeth prior to placement of embedment material

M. Except as otherwise required, excavate trenches below the underside of pipes as indicated in the Drawings to provide for installation of granular embedment pipe foundation material

N. Whenever so directed by Engineer, excavate to such depth below grade as Engineer directs and bring the trench bottom to grade with such material as Engineer may direct

O. For unstable soils, provide concrete or other bedding as directed by Engineer

P. Do not allow any part of bells or couplings to contact the trench bottom, walls, or granular embedment when pipe is joined

Q. Cuts in existing surface construction
1. No larger than necessary to provide adequate working space
2. Cut a clean groove not less than 1½ inch deep along each side of trench or around perimeter of excavation area
3. Remove pavement and base pavement to provide shoulder not less than 6 feet wide between cut edge and top edge of trench

4. Do not undercut trenches, resulting in bottom trench width greater than top widths
5. Make pavement cuts to and between straight or accurately marked curved lines parallel to trench centerline or limits of excavation
6. Remove pavement for connections to existing lines or structures only to the extent required for the installation
7. Replace the pavements between saw cuts to match original surface construction

3.014 PIPE EMBEDMENT

A. Embed pipes above and below the bottom of pipe as indicated on the Drawings and as specified herein

B. Granular embedment
1. Spread and surface grade granular embedment to provide continuous and uniform support beneath pipe at all points between pipe joints.
   a. Level bottom layer at proper grade to receive and uniformly support pipe barrel throughout length
   b. Barrel of pipe will have a bearing for its full length
2. Form depressions under each joint to permit the proper jointing. No part of joint will be in contact with trench when pipe is placed in position
3. After grading, aligning, and placing pipe in final position, and shoring home, deposit and compact sufficient embedment under and around each side of the pipe to hold the pipe in proper position and alignment during subsequent operations
4. Place and compact embedment material uniformly and simultaneously on both sides of pipe to prevent displacement
5. Complete embedment promptly after jointing operations and approval to proceed by Engineer
6. Granular embedment compaction by slicing with shovel or vibrating
   a. Maximum uncompacted thickness of layers: 6 inch
7. Compacted embedment will be compacted to 90 percent maximum density per ASTM D1557
   a. Maximum uncompacted depth thickness of horizontal layers: 8 inch

C. Arch and concrete encasement
1. Include in locations indicated on Drawings or where over-width trench conditions need correction as approved by Engineer
2. Install and form as indicated on Drawings or as specified
3. Concrete will have a 28-day minimum 3,000 psi compressive strength

D. Do not backfill until tests and inspections have been made and backfilling is authorized by Engineer. Use care in backfilling to avoid damage or displacement of pipe systems

3.015 TRENCH BACKFILL

A. Backfilling will be conducted in a continuous manner to prevent damage to the pipe and its coating and kept as close to the pipe laying operation as possible. Backfilling procedures will be in accordance with additional requirements, if any, of local authorities or private right-of-way agreements.

B. Compacted backfill
1. Provide full depth of trench above embedment at all locations
2. Beneath pavements, surfacing, driveways, curbs, gutters, walks or other surface construction or structures
3. In street or highway shoulders
4. Beneath fills and embankments

C. Where the trench for one pipe passes beneath the trench of another pipe, compact the backfill for the lower trench to the bottom of the upper trench

D. Site excavated materials
1. Place job excavated materials in 8 inches maximum uncompacted thickness, uniform layers.
2. Increased layer thickness may be permitted for incohesive material if Contractor demonstrates to Engineer's satisfaction that specified compacted density will be achieved

3. Use methods and equipment appropriate to the material to be compacted to prevent transmission of damaging shocks to pipe
4. Thoroughly compact each layer to meet the moisture and compaction specifications herein.

E. Graded gravel
1. Deposit in uniform layers of 9 inches maximum uncompacted thickness
2. Compact with suitable vibrating roller or platform vibrator to not less than 70 percent relative density per ASTM D4253/D4254

F. Uncompacted backfill
1. Compaction of backfill above pipe embedment in locations other than those specified, is required only to prevent future settlement
2. May be placed by any method acceptable to Engineer which will not impose excessive concentrated or unbalanced loads, shock, or impact on, and will not result in displacement of installed pipe
3. Until compacted depth over conduit exceeds 3 feet, do not drop fill material over 5 feet. Distance may be increased 2 feet for each additional 1 foot of cover

G. Finish the top portion of backfill with at least 4 inches of topsoil or as specified by landscaping specifications, whichever is greater, corresponding to, or better than, that underlying adjoining turf areas.

H. Trench backfill within the public right-of-way will conform to municipal street and utility standards.

I. Trench backfills through unimproved areas should be restored to previous conditions and left 3” above adjacent grades to allow for settlement. Seed all disturbed areas according to erosion control and landscape specifications.

J. Protection of trench backfill
1. Where trenches are constructed in ditches or other water courses, protect backfill from erosion
2. Install ditch checks where the ditch grade exceeds 1 percent
   a. Minimum depth: 2 feet below the original ditch or water course bottom for the full bottom width
   b. Minimum width: 18 inches into the side slopes
   c. Minimum thickness: 12 inches

3.016 DRAINAGE MAINTENANCE

A. Do not backfill trenches across roadways, drives, walks or other trafficways adjacent to drainage ditches or water courses prior to backfilling the trench on the upstream side of the trafficway to prevent impounding water after pipe is laid

B. Backfill so that water does not accumulate in unfilled or partially filled trenches

C. Remove materials deposited in roadway ditches or other water courses crossed by the trench line immediately after backfilling is completed and restore ditches and water courses to original section, grade, and contours

D. Do not obstruct surface drainage any longer than necessary

E. Provide and maintain temporary bridges and other structures across unfilled trenches as required to maintain traffic

F. Provide adequate storm flow conveyance through the site at all times during construction to avoid flooding of any buildings or adjacent property. Provide overland drainage routing when storm sewer inlets are not fully functioning due to erosion and sediment control measures.

3.017 FINAL GRADING

A. After completion of all other outside work and after backfilling is completed and settled, bring to grade at the indicated elevations, slopes and contours, all areas being graded on site

B. Graders and other power equipment may be used for final grading and slope dressing if the result is uniform and equivalent to hand work

C. Grade all surfaces for effective drainage, provide a 2 percent minimum slope except as otherwise shown on the Drawings

D. Provide a smooth transition between adjacent existing grades and new grades

E. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances

F. Slope grades to direct water away from buildings and prevent ponds from forming where not intended

G. Finish subgrades at lawns and unpaved areas to required elevations within a tolerance of plus or minus one (1) inch

H. Finish grades will be no more than 0.1 foot above or below those indicated

I. Finish all ditches, swales and gutters to drain readily

J. Coordinate final subgrade depth with finish landscape treatment and required topsoil depths

K. Topsoil
   1. Clean topsoil, free of plants and seed will be spread to 4-inch minimum depth, or as specified by landscaping specifications and Drawings, whichever is greater, for areas of the site as detailed by the landscape Drawings.
   2. Reuse grubbings and surface topsoil containing plants and seeds in designated revegetation areas only.

3.018 SLOPE AND CHANNEL STABILIZATION

A. Cover channel banks, slopes, bottom and thalweg (water flowline at lowest point in channel) with erosion control fabric mat where grade is steeper than 3H to 1V and where indicated on the Drawings

B. Lay fabric smoothly on surface, bury top end of each section in 6-inch deep excavated topsoil trench. Provide 6-inch overlap minimum of adjacent rolls. Backfill trench and rake smooth, level with adjacent soil

C. Secure outside edges and overlaps at 48 inch intervals with 4-inch to 6-inch U-shaped type pins or wooden stakes depending on ground condition

D. Lightly dress slopes with topsoil to ensure close contact between fabric and soil

E. At sides of ditches, lay fabric laps in direction of water flow. Lap ends and edges minimum 6 inches

F. Maintain integrity of erosion control fabric

G. Prior to laying fabric, seed disturbed areas under provisions of related seeding and landscaping specification sections.

3.019 SETTLEMENT

A. Warranty for settlement of all fills, embankments, and backfills is stipulated in the General Conditions from final completion of Contract under which Work is performed

B. Repair or replace within 30 days after notice by Engineer or Owner

3.020 FIELD QUALITY CONTROL

A. Provide under provisions of General Conditions and Division One Specifications

B. Coordinate testing with Owner. Owner will provide all field testing to determine compliance of in-place and backfill materials and compaction in accordance with the specifications, and to verify design bearing capacities.

C. It is the Contractor’s responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency contractually required, 24 hour, one business day advance notification to schedule tests.

D. Fills and Embankment Testing
   1. Two moisture-density relationship tests, ASTM D698, on each type of fill material

2. One in-place compaction test for each 5,000 square feet every 1.5 feet of vertical lift of material placed
3. Additional in-place compaction tests at the discretion of the Owner

E. Pipe Embedment and Backfill Testing
1. Two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate for each type of embedment on backfill material proposed, except granular embedment material
2. One in-place compaction test every 200 lineal feet of trench in the compacted embedment zone and at every 1.5 feet of vertical lift of backfill materials, per ASTM D6938
3. One in-place compaction test near top of trench for trench depth of 2 feet or less, per ASTM D6938
4. Additional in-place compaction tests at the discretion of the Owner

F. Pavement and Structural Subgrade Testing
1. At a minimum, two moisture-density relationship tests, ASTM D698, or two relative density tests, ASTM D4253/D4254, as appropriate and adequate for each type backfill material proposed.
2. Perform tests for each footing, concrete site feature, and drainage structure subgrade. Perform tests at every 100 linear feet of subgrade of foundation walls, retaining walls, and every 150 feet for curbing, pans, drainage features, walks, etc. (or portions thereof). Perform tests every 2,000 square feet required of building slab area, exterior slabs and pavement/flatwork areas (with no less than 3 tests). Test at subgrade and at every vertical lift of backfill materials placed.
3. Additional in-place compaction tests at the discretion of the Owner

G. Inspection and approval
1. A qualified Geotechnical Engineer will inspect the natural soil at bottom of excavations for structures
2. Do not prepare subgrade or place concrete until Geotechnical Engineer's inspection has taken place and any resulting recommendations of the Geotechnical Engineer have been fulfilled or until the inspection has been waived by the Geotechnical Engineer
3. Prior to placement of structural fill, overexcavated foundations subgrades will be observed and tested by a qualified Geotechnical Engineer to ensure suitable bearing materials exist
4. Geotechnical Engineer will provide a letter to Engineer to confirm the presence of suitable subgrade material and properly placed fill materials by Contractor in accordance with Drawings and geotechnical report.

H. Retesting of failed compaction will be performed by Geotechnical Engineer for Owner, but paid for the Contractor

END OF SECTION

SECTION 31 25 00
EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. This work consists of temporary measures needed to control erosion and water pollution. These temporary measures will include, but not be limited to, berms, dikes, dams, sediment basins, fiber mats, netting, gravel, mulches, grasses, slope drains, and other erosion control devices or methods. These temporary measures shall be installed at the locations where needed to control erosion and water pollution during the construction of the project and during site restoration, and as directed by ENGINEER, and as shown on the drawings.

B. The Erosion Control Plan presented in the drawings serves as a minimum for the requirements of erosion control during construction. Contractor has the ultimate responsibility for providing adequate erosion control and water quality throughout the duration of the project. Therefore, if the provided plan is not working sufficiently to protect the project areas, then Contractor shall provide additional measures as required to obtain the required protection.

1.02 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

B. Section 32 12 00 – Flexible Paving

C. Section 32 13 00 – Rigid Paving

D. Section 33 40 00 – Storm Drainage Utilities

1.03 REFERENCES AND STANDARDS

A. CDOT – Colorado Department of Transportation

B. MHFD – Mile High Flood District

C. CDPHE – Colorado Department of Public Health and Environment

1.04 SUBMITTALS

A. Submit under provisions of Division One specifications.

B. Submit the following information:
1. Erosion Control Plan,
2. Construction schedule for Erosion Control per Article Scheduling,
3. Sequencing Plan per Article Scheduling,
4. All applicable permits for Erosion Control.

C. Product data: Submit on all products or materials supplied herein.

1.05 REGULATORY REQUIREMENTS

A. Obtain and comply with all requirements of Jefferson County, Owner and CDPHE Stormwater and/or Groundwater Discharge Permits, as required.

B. 401 Construction Dewatering Industrial Wastewater Permit (Construction Dewatering Permit 401):
1. Contractor shall apply for and obtain a Construction Dewatering Permit 401 from the Colorado Department of Public Health and Environment.
2. All costs for this permit shall be the responsibility of Contractor.
3. This permit requires that specific actions be performed at designated times.
4. Contractor is legally obligated to comply with all terms and conditions of the permit including testing for effluent limitations.
5. Contractor shall allow the Colorado Department of Public Health and Environment or other representatives to enter the site to test for compliance with the permit.
6. Non-compliance with the permit can result in stoppage of all work.

C. In the event of conflict between these requirements and erosion and pollution control laws, rules, or regulations of other Federal, State, or local agencies, the more restrictive laws, rules, or regulations shall apply.

1.06 SCHEDULING

A. Sequencing Plan:
   1. Contractor shall submit a sequencing plan for approval for erosion control in conformance with Contractor's overall Construction Plan for approval by Jefferson County, Owner.
   2. Changes to the Erosion Control Sequencing Plan may be considered by Jefferson County, Owner, only if presented in writing by the Contractor.

B. Temporary Erosion Control:
   1. When so indicated in the Contract Documents, or when directed by Jefferson County, owner Contractor shall prepare construction schedules for accomplishing temporary erosion control work including all maintenance procedures.
   2. These schedules shall be applicable to clearing and grubbing, grading, structural work, construction, etc.

C. Contractor shall submit for acceptance the proposed method of erosion control on haul roads and borrow pits and a plan for disposal of waste material.

D. Contractor shall be required to incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Temporary erosion control measures shall then be used to correct conditions that develop during construction.

E. Work shall not be started until the erosion control schedules and methods of operations have been accepted.

PART 2 PRODUCTS

2.01 MATERIALS

A. Comply with all applicable municipal or local Municipal Separate Storm Sewer System (MS4) requirements.

B. All materials shall be submitted for approval prior to installation.

C. Natural or biodegradable materials shall be reasonably clean, free of deleterious materials, and certified weed free. Materials may include, but are not limited to, hay bales, straw, fiber mats, fiber netting, wood cellulose, fiber fabric, gravel.

D. Grass Seed:
   1. Temporary grass cover (if required) shall be a quick growing species, suitable to the area, in accordance with local criteria and permit requirements, which will provide temporary cover, and not compete with the grasses sown for permanent cover.
   2. All grass seed shall be approved by Landscape Architect, Jefferson County, Owner and in accordance with local regulations prior to installation.

E. Fertilizer and soil conditioners shall be approved by Landscape Architect, Jefferson County, and Owner and in accordance with local regulations prior to installation.

F. Silt Fence Fabric: woven polypropylene
   1. Mirafi 100X, "Envirofence"
   2. Or accepted substitution

G. Temporary Slope Stabilization Mat (extended term): 3.0 pound UV-stable polypropylene top net, 1.5 pound photodegradable polypropylene bottom net, 70% straw/30% coconut fiber matrix with a longevity of 24 months.
   1. North American Green SC150
   2. Or accepted substitution

PART 3 EXECUTION

3.01 GENERAL

A. All temporary and permanent erosion and sediment control practices will be maintained and repaired as needed to ensure continued performance of their intended function.

B. Jefferson County, Owner will monitor Contractor's erosion control methods. If the overall function and intent of erosion control is not being met, Jefferson County, Owner will require Contractor to provide additional measures as required to obtain the desired results.

C. The erosion control features installed by Contractor shall be adequately maintained by Contractor until the project is accepted.

3.02 PROTECTION OF ADJACENT PROPERITES

A. Properties adjacent to the site of a land disturbance shall be protected from sediment deposition.

B. In addition to the erosion control measures required on the drawings, perimeter controls may be required if damage to adjacent properties is likely, and may include, but is not limited to:
   1. Vegetated buffer strip around the lower perimeter of the land disturbance.
      a. Vegetated buffer strips may be used only where runoff in sheet flow is expected and should be at least twenty (20) feet in width.
   2. Sediment barriers such as straw bales, erosion logs, and silt fences.
   3. Sediment basins and porous landscape detention ponds.
   4. Combination of above measures.

3.03 CONSTRUCTION

A. Stabilization of Disturbed Areas:
   1. Temporary sediment control measures shall be established within five (5) days from time of exposure or disturbance.
   2. Permanent erosion protection measures shall be stablished within five (5) days after final grading of areas.

B. Stabilization of Sediment and Erosion Control Measures:
   1. Sediment barriers, perimeter dikes, and other measures intended to either trap sediment or prevent runoff from flowing over disturbed areas shall be constructed as a first step in grading and be made functional before land disturbance takes place.
   2. Earthen structures such as dams, dikes, and diversions shall be stabilized within five (5) days of installation.
   3. Stormwater outlets shall also be stabilized prior to any upstream land disturbing activities.

C. Stabilization of Waterways and Outlets:
   1. All onsite stormwater conveyance channels used by Contractor for temporary erosion control purposes shall be designed and constructed with adequate capacity and protection to prevent erosion during storm and runoff events.
   2. Stabilization adequate to prevent erosion shall also be provided at the outlets of all pipes and channels.

D. Storm Sewer Inlet Protection: All storm sewer inlets which are made operable during construction or which drain stormwater runoff from a construction site shall be protected from sediment deposition by the use of filters.

E. Construction Access Routes:
   1. Wherever construction vehicles enter or leave a construction site, a Stabilized Construction Entrance is required.
   2. Where sediment is transported onto a public road surface, the roads shall be cleaned thoroughly at the end of each day.
   3. Sediment shall be removed from roads by shoveling or sweeping and be transported to a sediment controlled disposal area.
   4. Street washing shall be allowed only after sediment is removed in the manner described above.

3.04 DISPOSITION OF TEMPORARY MEASURES

A. All temporary erosion and sediment control measures shall be disposed of within thirty (30) days after final site stabilization is achieved or after the temporary measures are no longer needed as determined by Jefferson County, Owner.

B. Trapped sediment and other disturbed soil areas resulting from the disposition of temporary measures shall be permanently stabilized to prevent further erosion.

C. Substantial Completion of Erosion Control Measures:
   1. At the time specified in the Contract Documents, and subject to compliance with specified materials and installation requirements, Contractor shall receive a Substantial Completion Certificate for temporary erosion control measures.
   2. Maintenance of Erosion Control Measures after Substantial Completion: Contractor shall be responsible for maintaining temporary erosion control measures as specified in the drawings and Contract Documents until such time as work has been accepted by Jefferson County, Owner and as specified in Division 1 for Closeout Procedures.

END OF SECTION

SECTION 31 66 13
AGGREGATE PIERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section Includes:
   1. Aggregate Piers.

B. Related Sections:
   1. Section 311000 "Site Clearing" for preparation of subgrade for aggregate pier operations including removal of vegetation, topsoil, debris, obstructions, and deleterious materials from ground surface.
   2. Section 312000 “Earth Moving” for preparing and grading subgrades and placement of structural fill.

1.03 PERFORMANCE REQUIREMENTS

A. Provide all equipment, material, labor, and supervision to design and install aggregate piers.

B. The design of the aggregate pier system shall be based on the service load bearing pressure and the allowable total and differential settlement criteria. The aggregate pier system shall be designed in accordance with generally accepted engineering practice and the methods described in these Specifications.

C. The design shall meet the following criteria.
   1. Allowable Bearing Pressure for Footings supported by Aggregate Pier Reinforced Soils: 4000 psf.
   2. Total Long-Term Settlement for Footings: ≤ 1 inch.
   3. Long-Term Differential Settlement of Adjacent Footings: ≤ 1/2 inch.

D. The aggregate pier elements shall be designed using an aggregate pier stiffness modulus to be verified by the results of the modulus test.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated, including:
   1. Aggregate

B. Aggregate Pier Layout Drawings, indicating identification number, location, spacing, diameter, and depth of aggregate piers.

C. Detailed design calculations.

D. Drawings and Calculations shall be signed and sealed by the qualified professional engineer, registered in the State of the project, who was responsible for their preparation.

E. Ground improvement QA plan.

F. Quality control test program and modulus test detail and setup for aggregate pier system.

G. Modulus Test Reports – A modulus test shall be performed by the aggregate pier contractor to verify the design assumptions. The aggregate pier contractor shall furnish a description of the installation equipment, installation records, complete test data, analysis of the test data and verification of the design parameter values based on the modulus test results. The report shall be prepared under direction of a Registered Professional Engineer.

H. Daily Aggregate Pier Progress Reports: Furnish a complete and accurate record of aggregate pier installation.
   1. Pier location, identification number, length, and diameter.
   2. Final elevations of the pier top and bottom.

3. Type and size of compaction equipment and predrill auger diameter used.
4. Documentation of any changes in subsurface conditions encountered.
5. Soil and groundwater observations.

I. Upon completion of work, submit a report documenting the observations and results of the tests. This report shall certify that the design modulus value has been achieved within settlement tolerances.

1.05 QUALITY ASSURANCE

A. Modulus Testing Standards:
1. ASTM D 1143 - Standard Test Methods for Deep Foundations Under Static Axial Compressive Load

B. Materials and Inspection Standards:
1. ASTM D 1241 - Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses

C. The aggregate pier contractor shall provide evidence of satisfactory experience with the design and installation of aggregate pier soil reinforcement systems, including examples of at least 5 previous projects for which the contractor has supported comparable structural loads and controlled settlement to the project tolerances. The design and installation shall be conducted and overseen by a registered professional engineer employed by the contractor.

D. The aggregate pier contractor shall maintain Quality Control records during pier installation. This work shall be conducted under the supervision of a registered professional engineer employed by the installer.

E. The aggregate pier contractor shall provide a certified quality control representative to observe the drilling and construction of all engineered aggregate piers. Quality Control observations shall include confirmation that all aggregate lifts have been constructed to the design criteria, as established by the aggregate pier design engineer.

F. The engineer of the aggregate pier system shall carry Errors and Omissions/Professional Liability Insurance with coverage of at least $2 Million per occurrence and $3 Million aggregate.

G. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of aggregate piers that are similar to those indicated for this Project in material, design, and extent.

H. Contractor’s Design Engineer and Quality Control representative shall each have a minimum of 5 years of documented experience with aggregate piers constructed as specified herein.

I. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to provide special inspections and testing indicated.

1.06 PROJECT CONDITIONS

A. Existing Utilities: Locate existing underground utilities before excavating for piers. If utilities are to remain in place, provide protection from damage during operations.
1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

B. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:
1. Notify Owner no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

C. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of the geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by the

geotechnical engineer. Owner will not be responsible for interpretations or conclusions drawn from this data.

1. The geotechnical report is included elsewhere in the Project Manual.
    a. The boring log and accompanying report are believed to be accurate; however, neither the owner, architect, nor structural engineer guarantees the information contained therein, nor do they guarantee the conditions indicated to exist at the locations of the test holes will prevail at other locations on the site.

D. Survey Work: Engage a qualified surveyor to perform surveys, layouts, and measurements for aggregate piers. Before excavating, lay out each aggregate pier to lines and levels required. Record actual measurements of each pier's location, shaft diameter, bottom and top elevations, deviations from specified tolerances, and other specified data.

1. Record and maintain information pertinent to each aggregate pier and cooperate with Owner's testing and inspecting agency to provide data for required reports.

PART 2 PRODUCTS

2.01 AGGREGATE

A. Aggregate for the piers shall consist of materials that are in general conformance with gradation requirements as specified by the aggregate pier engineer. During wet weather conditions, the aggregate shall contain less than 5 percent fines. The aggregate pier system engineer shall make the determination of acceptable materials to be used in pier construction.

B. Potable water or other suitable source shall be used to increase aggregate moisture content as needed for workability. The need for moisture conditioning aggregate shall be made by the aggregate pier contractor based on workability and/or dust control.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which aggregate piers are to be installed.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created by pier operations.

B. Site subgrade established shall be within 6 inches of finish subgrade, or as approved by the aggregate pier contractor.

C. Where the adjacent building is within 15 ft of the aggregate pier work area, a relevant building examination shall be performed prior to initiating work to document preexisting cracks/damage. The building must also be monitored for movement during any work within 15 ft of the structure. The work shall be stopped, and the engineer notified if any building settlement is observed.

3.03 INSTALLATION

A. The locations, size, and spacing of aggregate pier elements are described on the appropriate drawings or details. Any modifications in size and spacing of the aggregate pier element layout shall be approved by the aggregate pier system engineer.

B. The aggregate pier contractor shall use one of the following construction methods:

1. Down-Hole Vibrator.
2. Down-Hole Tamper/Rammer

C. Prior to installing production piers, the aggregate pier engineer shall establish the required energy output to achieve compaction of each lift. Energy output shall be confirmed by the contractor prior to construction of production piers.

1. Where down-hole vibrator construction method is used, an appropriate metering device should be provided at such a location that inspection of amperage increase may be verified during the operation of the equipment. The metering device may be an ammeter directly indicating the performance of the vibrator tip.

2. Where down-hole tamper/rammer construction method is used, rammer-blow deflection monitoring shall be performed randomly on a minimum of 10% of the installed piers to confirm that terminal rammer-blow deflections meet the established acceptance criterion. The aggregate pier engineer shall establish the required energy output for the rammer and establish terminal rammer-blow deflection criterion. Instrumentation used to confirm rammer-blow deflections shall be capable of recording to a precision of at least 0.001 inch per rammer stroke and shall be capable of recording deflection accompanying each rammer blow. During pier construction, rammer-blow deflections shall be monitored to confirm that the design deflection per rammer-blow is achieved.

D. Stable Ground Conditions: The following general procedures shall be followed when the pre-drilled hole remains open during construction.
   1. Pre-drilling to the design depth will be performed with an auger diameter equal to the finished column diameter.
   2. Down-Hole Vibrator Method: The quantity of aggregate initially added shall be such that the vibrator tip is able to penetrate to within 12 inches of the design depth. The vibrator will be raised and lowered repeatedly, such that on each re-penetration, the tip of the vibrator advances to within 12 inches of the previous penetration depth.
   3. Down-Hole Tamper/Rammer Method: The bottom of the pier excavation shall be compacted prior to the placement of aggregate. If wet, soft or sensitive soils are present, open graded aggregate shall be placed and to stabilize the pier bottom and may serve as the initial pier lift. Following placement of the first lift of aggregate, the tamper/rammer is to be lowered to the top of the aggregate and activated. Subsequent lifts shall not exceed thickness determined by the aggregate pier engineer.
   4. The aggregate shall be removed and replaced with fresh aggregate if cave-ins occur during the aggregate placement such that the volume of caved-in soil is greater than 10 percent of the aggregate being compacted.

E. Unstable Ground Conditions: The following general procedures will be followed when a pre-drilled hole will not remain open before or during pier construction.
   1. Down-Hole Vibrator Method: If the hole will remain temporarily stable, the hole may be filled with aggregate to a level above the instability as long as the vibrator is still able to penetrate to within 1 foot of the pre-drilled depth. If the hole will not remain temporarily stable, a Bottom Feed Down-Hole vibrator may be used.
   2. Down-Hole Tamper/Rammer Method: A casing with a minimum outside diameter equal to 100% of the pier diameter is advanced to the full treatment depth. The bottom of the pier excavation shall be compacted prior to the placement of aggregate. Open graded aggregate shall be placed to stabilize the pier bottom and may serve as the initial pier lift. Subsequent lifts shall not exceed thickness determined by the aggregate pier engineer. The casing is extracted after each lift is compacted with the bottom of the casing always maintained below the top of the aggregate.

F. Should any obstruction, including but not limited to cobbles, boulders, timber, concrete, asphalt, large roots etc., be encountered which prevents placing the elements to the required depth, or causes the aggregate pier to drift from the required location, the obstruction shall be removed. Additional aggregate pier elements shall be installed when required by the presence of obstacles.

G. The center of each constructed aggregate pier element shall be within 6 inches of the design location. Foundation elements installed outside of the above tolerance and deemed not to be acceptable, shall be either rebuilt or other remedial measures taken as approved by the aggregate pier system engineer.

H. Casing for elevator jack shafts located within 10 feet horizontally of any aggregate element shall be installed prior to aggregate pier installation and shall be grouted in-place for the full length of the casing.

I. Acceptable constructed lift thickness shall be established by the aggregate pier engineer and confirmed by the aggregate pier contractor for each lift installed.

J. Required compaction for each lift shall be established by the aggregate pier engineer and shall be consistent with the criteria used for the test pier construction.

K. Aggregate piers installed beyond the maximum allowable tolerances shall be abandoned and replaced with new piers, unless the aggregate pier engineer approves the condition or provides other remedial measures. All material and labor required to replace rejected piers shall be provided at no additional cost to the Owner, unless the cause of rejection is due to an obstruction.

3.04 AGGREGATE PIER MODULUS TESTING

A. Testing to determine specification compliance shall be provided by the aggregate pier contractor and will consist of at least one modulus test of an aggregate pier.

B. Where down-hole tamper/rammer construction method is used, modulus test data shall be used by the aggregate pier system engineer to supplement rammer blow deflection monitoring to confirm aggregate pier element design parameters for the project. Test piers used for modulus testing shall be constructed using rammer deflection monitoring.

C. Aggregate pier elements used for modulus testing which are located within tolerance and provide a safe design capacity may, upon approval of the aggregate pier system engineer, be used in the finished work.

D. Compressive load test procedures shall be conducted in general accordance with ASTM D1143. A test pier shall be loaded to 150 percent of the estimated element design pressure. Alternatively, at the discretion of the aggregate pier engineer, the modulus test may be terminated when a modulus equal to 150 percent of the modulus used in the design is achieved.

E. The modulus test shall be conducted as follows:
   1. ASTM D1143 test procedures shall be used as a guide to establishing load increments, load increment duration, load decrements, and total applied load.
   2. The test pier shall be constructed in such a manner that deflections at both the bottom and top of the pier can be measured at each increment of loading.
   3. With the exception of the load increment representing approximately 112% of the design maximum aggregate pier element stress, all load increments shall be held for a minimum of 15 minutes, a maximum of 1 hour, and until the rate of deflection reduces to 0.01 inch per hour, or less.
   4. The load increment which represents approximately 112% of the design maximum aggregate pier element stress shall be held for a minimum of 15 minutes, a maximum of 4 hours, and until the rate of deflection reduces to 0.01 inch per hour, or less.
   5. A seating load equal to 5 percent of the total load shall be applied to the loaded steel plate prior to application of load increments and prior to measurement of deflections to compensate for surficial disturbance.
   6. The test data shall be presented as a graph showing deflection of the pier top and bottom under each load increment.
   7. At the design load, deflection measured at the top of the pier shall not exceed the design settlement for the aggregate pier-reinforced soil zone, and the ratio of bottom plate deflection to top plate deflection shall not exceed 0.25 unless specifically approved by the aggregate pier engineer.

3.05 FOOTING SUBGRADE PREPARATION

A. Excavation and surface compaction of all footings shall be the responsibility of the Contractor.

B. Foundation excavations to expose the tops of aggregate pier elements shall be made in a workmanlike manner, and shall be protected until concrete placement, with procedures and equipment best suited to (1) prevent softening of the matrix soil between and around the aggregate pier elements before pouring structural concrete, and (2) achieving direct and firm contact between the dense, undisturbed aggregate pier elements and the concrete footing.

C. Footing excavations shall be kept free of water.

D. Foundation excavations shall be constructed as follows:

1. Limit over-excavation below the bottom of the footing to 3-inches (including disturbance from the teeth of the excavation equipment). Over-excavation shall be backfilled with material matching aggregate pier.
2. Compaction of surface soil and top of aggregate pier elements shall be prepared using a motorized impact compactor ("Wacker Packer," "Jumping Jack," or similar). Sled-type tamping devices shall not be used. Compaction shall be performed over the entire footing bottom to compact any loose surface soil and loose surface pier aggregate.
3. Place footing concrete immediately after footing excavation is made and approved, preferably the same day as the excavation. Footing concrete must be placed on the same day if the footing is bearing on expansive or sensitive soils.
4. If same day placement of footing concrete is not possible, place a minimum 3-inch thick lean concrete seal ('mud mat") immediately after the footing is excavated and approved or an alternative subsurface protection layer that may consist of a geotextile fabric and six inches of crushed stone to prevent softening or disturbance of the subgrade soils.
5. Confirm that immediately before footing construction or placement of an alternate subgrade protection layer, the tops of all the aggregate pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical compaction equipment, and that the tops of any aggregate pier elements which may have been disturbed by footing excavation and related activity have been recompacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified Proctor method (ASTM D-1557).

E. No excavations or drilled shafts (elevator, etc) shall be made after installation of Aggregate Pier elements within a horizontal distance of 10' from the edge of any pier, without the written approval of the aggregate pier contractor.

3.06 FIELD QUALITY CONTROL

A. The aggregate pier contractor shall have a full-time, on-site Quality Control representative to verify and report all installation procedures. The contractor shall immediately report any unusual conditions encountered during installation to the aggregate pier engineer, the General Contractor, and to the Special Inspection Agency. Submit daily aggregate pier progress reports, as indicated.

B. Special Inspections: Owner will engage a qualified special inspector to perform special inspections on a full-time basis.

C. Aggregate Pier Inspections: The special inspector shall log the following during installation for comparison with anticipated conditions and design parameters (from the engineer/contractor).
1. Pier Identification
2. Plan Top Elevation
3. Date of Excavation
4. Actual Ground Elevation
5. Designed Pier Length
6. Designed Pier Diameter
7. As-Installed Depth of Pier Excavation
8. As-installed Pier Bottom Elevation
9. As-installed Total Pier Length
10. Soil Type(s) Encountered by Pier Excavation
11. Soil Type at Pier Excavation Bottom
12. Date of Aggregate Placement
13. Type/Description of Aggregate
14. Number of Aggregate Lifts Placed
15. Average Aggregate Lift Thickness
16. Actual Compaction Time
17. Rammer Blow Deflections (for down-hole tamper/rammer construction method)
18. Energy Output
19. Length of Casing Installed (if any)

D. Footings bearing on Aggregate Piers: The special inspector shall confirm:
   1. That water (which may soften the unconfined matrix soil between and around the aggregate pier elements and may have detrimental effects on the supporting capability of the aggregate pier reinforced subgrade) is not ponding in the footing and there is no evidence of previous water ponding.
   2. That all aggregate pier elements designed for each footing have been exposed in the footing excavation.
   3. That immediately before footing construction, the tops of aggregate pier elements exposed in each footing excavation have been inspected and recompacted as necessary with mechanical (not vibratory) compaction equipment; and that the tops of any pier elements which may have been disturbed by footing excavation and related activity have been recompacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified AASHTO compaction procedure (ASTM D1557).
   4. That any structural fill placed between the tops of aggregate pier elements and the bottoms of foundations consists of the same quality and gradation material, or better, as used in constructing the piers; and that the fill has been compacted to a dry density equivalent to at least 95% of the maximum dry density obtainable by the modified AASHTO compaction procedure (ASTM D1557);
   5. That no excavations or drilled shafts (elevator, etc) have been observed within a horizontal distance of 10’ from the edge of any pier.

3.07 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove all soil and waste material, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 32 01 90.33
PROTECTION / REPAIR OF EXISTING TREES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Protecting existing trees.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

PART 2 PRODUCTS

2.01 MATERIALS

A. Orange safety fence.

PART 3 EXECUTION

3.01 INSTALLATION

A. All trees within area available to the Contractor for construction shall be protected with orange safety fence around the trunk and dripline of the tree.

B. When setting up construction limits lines for construction, construction access and material storage, the Contractor shall fence or similarly protect restricted zones around all trees. These restricted zones shall extend from dripline to dripline. In any areas where the restricted zones must be violated, it shall be done only with the approval by the City Forester. If access is allowed within these areas the use of heavy construction equipment shall be severely restricted in order to mitigate soil compaction and damage to tree roots.

C. Hand dig all trenches within dripline of existing trees. Do not cut roots greater than 1" diameter. All exposed roots shall not be exposed for longer than 4 hours. If tree roots larger than 1" inch in diameter are encountered when digging or trenching they shall be tunneled under for the placement of pipe, or other improvements. Where tree roots smaller than 1" inch in diameter are in direct conflict with the exact final physical location of any of the proposed improvements, the roots shall be hand pruned with pruners for a clean cut. Do not tear roots out and do not cut with trenching equipment. Cutting of 1" inch or larger roots encountered during construction will not be allowed. Contractor shall propose alternate trench routing in the field if it is possible to have less of an impact on existing trees and plant material. All revisions shall be approved by the Owner prior to trenching.

D. Aeration: If areas inside the restricted zone become compacted, the contractor shall use a grow gun or equal to fracture the soil. Fracturing penetration shall be 5' on center throughout the compacted areas.

E. Supplemental watering shall be applied with a deep root feeder, with about 100 gallons per tree per week if loss of ground cover (grass) or heating of the tree roots occur during construction.

F. No chemicals shall be applied or used around or near existing trees.

3.02 PROTECTION

A. General: Continue to protect trees throughout the completion of construction.

B. When construction is complete, remove orange safety fence from around trees.

C. If it appears that the completion of the construction may cause damage to the branches of any trees, the Contractor shall contact the Landscape Architect. The Landscape Architect will make a determination as to whether such damage is eminent. If so, the Contractor shall have a licensed arborist prune the trees to facilitate the construction.

D. For each tree erroneously removed or damaged beyond repair, an assessment shall be withheld for the CONTRACTOR's progress payments. This assessment shall be equal to the value of the tree prior to damage as determined by the Landscape Architect.

E. In addition to paying the assessment, the contractor shall replace each damaged tree with nursery grown material of the same or approved species and approved size.

END OF SECTION

SECTION 32 12 00
FLEXIBLE PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Full depth and/or composite hot bituminous pavement (asphalt) over prepared subgrade

B. Overlay, patch and/or pavement rehabilitation applications for streets, parking lots and other miscellaneous asphalt pavement

1.02 RELATED SECTIONS

A. Section 01 02 00 – Geotechnical Report

B. Section 31 00 00 – Earthwork

C. Section 32 13 00 – Rigid Paving

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. T 230: Standard Method of Test of Determining Degree of Pavement Compaction of Bituminous Aggregate Mixtures

B. American Society for Testing and Materials (ASTM):
   1. C29: Unit Weight and Voids in Aggregate
   2. C88: Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
   3. C117: Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing
   4. C128: Specific Gravity Test and Absorption of Fine Aggregate
   5. C131: Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
   6. C136: Sieve or Screen Analysis of Fine and Coarse Aggregates
   7. D70: Specific Gravity of Semi-Solid Bituminous Materials
   8. D2726: Bulk Specific Gravity of Compacted Bituminous Mixtures
   9. D2041: Theoretical Maximum Specific Gravity of Bituminous Paving Mixtures
   10. D4462: Viscosity of Asphalts (Bitumens)
   11. 2172: Quantities Extraction of Bitumens from Bituminous Paving Mixtures
   12. D2419: Sand Equivalent Value of Soils and Fine Aggregate
   13. D290: Bituminous Mixing Plant Inspection
   14. D6373: Performance Graded Asphalt Binder
   15. D692: Course Aggregate for Bituminous Paving
   16. D1073: Fine Aggregate for Bituminous Paving Mixtures
   17. D1241: Materials for Soil-Aggregate Subbase, Base and Surface Courses
   18. D2026: Cutback Asphalt (Slow-Curing Type)
   19. D2027: Cutback Asphalt (Medium-Curing Type)
   20. D2028: Cutback Asphalt (Rapid-Curing Type)
   21. D2950: Density of Bituminous Concrete in Place by Nuclear Methods

C. Surface Preparation Standards (SSPC)
   1. SP-2: Superior Performing Asphalt Pavement System (Superpave) Level 1 Mix Design

D. Colorado Department of Transportation

E. Colorado Asphalt Pavement Association

F. Jefferson County construction specifications, standards and details.

1.04 SUBMITTALS

A. Submit under provisions of Division One Specifications

B. Record of Work: Maintain record of time and date of placement, temperature, and weather conditions, retain until completion and furnish copy to engineer.

C. Proposed Design Job Mix Formula for each mixture required by the contract. The mixture design shall be determined using AASHTO T-312 or Colorado Procedure CP-L 5115 for the Superpave Method of Mixture Design.

D. Test Reports: Proposed Design Job Mix testing shall be performed in a materials laboratory under the direct supervision of; and shall be stamped and signed by a Professional Engineer licensed in the State of Colorado practicing in this field. In addition, the General Contractor shall submit as part of the Proposed Design Job Mix, documents to verify the following:
   1. Source of materials
   2. Gradation, specific gravity, source and description of individual aggregates and the final blend
   3. Aggregate physical properties
   4. Source and Grade of the Performance Graded Binder (PG Binder)
   5. Proposed Design Job Mix – aggregate and additive blending, final gradation shown on 0.45 power graph, optimum asphalt content
   6. Required mixing and compaction temperatures
   7. Mixture properties determined at a minimum of four asphalt contents and interpolated at optimum and graphs showing mixture properties versus asphalt content.
   8. Sampling and testing of asphalt concrete mixtures for quality control during paving operations
      a. Uncompacted asphalt concrete mix
         i) Asphalt cement content: ASTM D2172 (AASHTO T164)
         ii) Maximum Specific Gravity: ASTM D2041 (AASHTO T209)
      b. Compacted asphalt concrete mix
         i) Bulk density: ASTM D1188 (AASHTO T166)
      c. Perform at least one test for each day's paving but not less than one test per each 4000 sf of each lift.

1.05 QUALITY ASSURANCE

A. Materials and installation shall conform to applicable portions of Colorado Department of Transportation (CDOT) and Jefferson County construction specifications, standards and details.

1.06 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of Jefferson County construction specifications, standards and details for the construction of concrete, curbs, gutters, sidewalks, driveways, roadways, street paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Transport mixture from mix plant in trucks with tight, clean, smooth, non-sticking compartments. Thinly coat hauling compartments with lime-water mixture, paraffin oil or other approved release agent to prevent sticking. Petroleum distillates such as kerosene or fuel oil are not approved release agents. Elevate and drain compartment of excess solution before loading mix.

C. Cover to protect from weather and prevent loss of heat

D. Provide insulated truck beds during temperature below 50 degrees F on long distance deliveries

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not apply when underlying surface is muddy, frozen or wet

B. Weather conditions permit pavement to be properly placed and compacted

C. The hot mix asphalt will be placed only when both the air and surface temperatures are equal to or exceed the temperatures specified in the table below:

CDOT Table 401-3: Placement Temperature Limitations in F

Compacted Layer Thickness (Inches)	Minimum Air and Surface Temp. (Degrees F and rising)	
	Top Layer	Other Layers
1½ or less	60	50
>1½ to 3	50	40
3 to 4	45	35

Air temperature shall be taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Pavement shall be asphalt of the plant hot mix type. Materials and construction shall comply with Section 403 and 702 of the CDOT Standards and Specifications for Road and Bridge Construction.

B. Tack Coat:
1. SS-1 or CSS-1h
2. AASHTO M208 or M140

C. Asphaltic Cement:
1. Superpave Performance Graded (PG) binder of PG64-22 or PG58-28 Table 702-1 of CDOT standard section 702
2. Will not be acidic modified or alkaline modified
3. Will not contain any used oils that have not been refined
4. Modifiers will not be carcinogenic

D. Aggregate for Asphaltic Concrete, General
1. Sound, angular crushed stone, crushed gravel, or crushed slag: ASTM D692
2. Sand, stone, or slag screening: ASTM D1073
3. Percent wear: ASTM C131, less than 45 for aggregates retained in #10 sieve

E. Base Course Aggregates for Asphaltic Concrete
1. Uncrushed gravel may be used in mixture if it meets design criteria specified
2. Provide uniform quality combined aggregates with a minimum sand equivalent value of 40
3. Provide aggregate in gradations for courses to comply with Class S and SG, Colorado Department of Transportation, ASTM C136

F. Surface Course Aggregates for Asphaltic Concrete
1. Provide natural sand, unless sand prepared from stone, slag, or gravel or combinations are required to suit local conditions
2. Provide uniform quality combined aggregate with a minimum sand equivalent value of 50
3. Provide aggregate in gradations for courses to comply with Class SX, Colorado Department of Transportation, ASTM C136.

G. Hydrated Lime for Aggregate:
1. May be added at the rate of 1% by dry weight of the aggregate and shall be included in the amount of material passing the No. 200 sieve. Hydrated lime for aggregate pretreatment will conform to ASTM C207, Type N. Residue retained on a No. 200 sieve will not exceed 10% when determined

in accordance with ASTM C110. Drying of the residue in an atmosphere free from carbon dioxide will not be required.

H. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.02 ACCESSORIES

A. Traffic Control Devices
   1. Signs.
      a. Comply with Jefferson County standards and specifications for signs within the public right-of-way.
      b. Sign faces, posts and bases shall be in conformance with the following materials specifications. All nonstandard sign faces, posts and bases must be approved by Jefferson County. Private property or nonstandard signs will be maintained by the owner. Submit shop drawings for approval prior to fabrication. All signs shall conform to current M.U.T.C.D. Standards and Colorado Supplements. All signs shall be 3M-engineer grade reflective sheeting or accepted substitute.
      c. Traffic/Parking Signs: Sign blanks shall be 6061 or 5052-H38 aluminum alloy .080 inches thick. Facing shall be specified reflective sheeting with standard sign colors based on standard graphics and as shown on the plans.
   2. Sign Posts.
      a. For large signs greater than 12”W x 18”H and for multiple signs of any size mounted on the same post: sign posts shall be two (2) inch by two (2) inch galvanized telespar tube.
      b. For regular single signs 12”W x 18”H or smaller: sign posts shall be one and one-half (1-1/2) inch by one and one-half (1-1/2) inch galvanized telespar tube.
      c. Galvanized telespar tube shall have 0.120-inch wall thickness, and three-eighths (3/8) inch holes drilled on one (1) inch centers, all sides over full length, ten (10) feet in length (min).
   3. Sign Post Anchor Bases (Stubs). All sign post anchor bases shall be twist resistant square galvanized telespar tube post with thickness and hole pattern the same as sign posts. Use 2-1/4” by 2-1/4” anchor for large posts and 1-3/4” by 1-3/4” anchor for regular posts. Bases shall be embedded a minimum of 36” below finished grade and shall extend 3” above finished grade.
   4. Signs Post Anchor Bases with concrete footing: Sign, post, base and compacted soil shall be rigid and able to withstand wind loads. Where predominantly clay soils are present which will not properly compact at sign base, install a 6” diameter by 36” deep concrete footing around signs post anchor base for all signs in landscaped areas.
   5. All signs and posts shall be mounted and secured with municipal-approved vandal-proof type TL-3896 drive rivets with washers, or accepted substitute.

B. Pavement Marking. Specified pavement marking materials shall be used at locations as identified below.
   1. Comply with Jefferson County standards and specifications for pavement marking within the public right-of-way.
   2. FS TT-P-1952, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
   3. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.
   4. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way. Use of thermoplastic pavement marking is not permitted.

2.03 MIXES/SOURCE QUALITY CONTROL

A. Determine full depth design mix based upon aggregates furnished
   1. Test mix by independent laboratory at Contractor's expense
   2. Grade dependent on temperature during placement
   3. Submit mix designs under provisions of Division One specifications for review and acceptance by Engineer

B. Submit mix design giving unit weight and to meet following requirements prior to placement of asphalt:

Property	S(75)	SX(75)
Air Voids in Mix, % (N Design)	3.5-4.5	3.5-4.5
Initial Gyrations	7	7
Design Gyrations	75	75
Hveem Stability	28 min	28 min
Voids Filled w/ Asphalt	65-80	65-80

Establish a single percentage passing each sieve size, a single percent of asphalt and a mix temperature. Maintain job mixes within following percentages of design mix:

Aggregates:	
¾" and larger	± 6%
#4 to #8	± 5%
#30	± 4%
#200	± 2%
Asphalt Content Tolerance	± 0.3%
Discharge Mix temp	± 20˚ F

PART 3 EXECUTION

3.01 EXAMINATION

A. Establish and maintain required lines and elevations. Provide grade and location stakes under this section as required for asphaltic concrete paving work.

B. Operate heavy, rubber-tired front loader over subgrade of paved areas. Where soft spots occur, remove loose materials and replace with Class 6 road base aggregate complying with CDOT standards compacted to level of subgrade.

3.02 PREPARATION

A. Prepare subgrade under provisions of Section 31 00 00

B. Loose and Foreign Material
   1. Remove loose and foreign material from compacted subgrade surface immediately before application of paving. Clean surface with mechanical sweeper, blowers, or hand brooms, until surfaces are free from dust

C. Weed Control
   1. If weeds or vegetation exist at or on the subgrade, apply “Round-up” at rates following manufacturer’s instructions. Apply “Round-up” three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow “Round-up” to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.

2. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing asphalt or aggregate base course, all subgrade soil in the area to receive asphalt pavement shall be thoroughly treated with Casoron soil sterilant (in addition to "Round-up" and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
3. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor's expense.
4. Do not apply within 20 feet of trees or shrubs

D. Tack Coat
1. Apply in similar manner as prime coat, except as modified
2. Dilute material with equal parts of water and apply to contact surfaces of previously constructed asphaltic concrete or portland cement concrete and surfaces
3. Apply at rate of 0.05 to 0.15 gallons per square yard of surface
4. Apply tack coat by brush to contact surfaces of curbs, gutters, catch basins, and other structures projecting into or abutting asphaltic concrete pavement
5. Allow surfaces to dry until material is at condition of tackiness to receive pavement
6. Where asphaltic concrete will adhere to surface, tack coat may be eliminated by Engineer

3.03 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to minimum depth of 1 ½-inches, or as indicated on the plans.
2. Mill to a uniform finished surface free of gouges, grooves, and ridges of more than ¼ inch depth.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Transport milled hot-mix asphalt to asphalt recycling facility.
7. Keep milled pavement surface free of loose material and dust.

3.04 RING/FRAME ADJUSTMENTS

A. Set ring/frames of subsurface structures to final grade as a part of this work.

B. Placing Ring/Frames
1. Surround ring/frames set to elevation with a ring of compacted asphalt concrete base prior to paving
2. Place asphalt concrete mixture up to 1-inch below top of ring/frame, slope to grade, and compact by hand tamping

C. Adjust frames to proper position to meet paving

D. If permanent covers are not in place, provide temporary covers over openings until completion of rolling operations

E. Set ring/frames to grade, flush with surface of adjacent pavement

3.05 PREPARING THE MIXTURE

A. Comply with ASTM D995 for material storage, control, and mixing and for plant equipment and operation

B. Stockpile
   1. Keep each component of the various sized combined aggregates in separate stockpiles
   2. Maintain stockpiles so that separate aggregate sizes will not be intermixed and to prevent segregation

C. Heating
   1. Heat the asphalt cement at the mixing plant to viscosity at which it can be uniformly distributed throughout mixture
   2. Use lowest possible temperature to suite temperature viscosity characteristics of asphalt
   3. Do not exceed 350 degrees F

D. Aggregate
   1. Heat-dry aggregates to acceptable moisture content
   2. Deliver to mixer at recommended temperature to suite penetration grade and viscosity characteristics of asphalt cement, ambient temperature, and workability of mixture
   3. Accurately weigh or measure dry aggregates and weigh or meter asphalt cement to comply with job-mix formula requirements

E. Mix aggregate and asphalt cement to achieve 90-95 percent coated particles for base mixtures and 85-90 percent coated particles for surface mixture, per ASTM D2489

3.06 EQUIPMENT

A. Bituminous Pavers:
   1. Self-propelled, spreads without tearing surfaces, equipped with an activated screed assembly, heated if necessary, controls pavement edges to true lines without use of stationary forms and capable of spreading and finishing the asphalt plant mix material in widths applicable to the typical sections and thicknesses shown in the contract documents.
   2. Pavers will be equipped with automatic screed controls with sensors capable of sensing grade from an outside reference line, and maintaining the screed at the specified longitudinal grade and transverse slope. The sensor will be constructed to operate from either or both sides of the paver and will be capable of working with the following devices:
      a. Ski-type device at least 30 feet in length
      b. Short ski or short shoe
      c. At least 5,000 feet of control line and stakes
   3. The controls will be capable of maintaining the screed at the specified transverse slope within plus or minus 0.1 percent.
   4. Manual operation will be permitted:
      a. For constructing irregularly shaped or minor areas
      b. If the automatic controls fail or malfunction the equipment may be operated manually for the remainder of the normal working day, provided specified results are obtained. However, if specified surface tolerances cannot be achieved, paving operations will be suspended until satisfactory correction, repairs of equipment replacements are made.

B. Rolling Equipment
   1. Steel-wheel roller: Self-propelled, contact pressure of 250 to 350 psi per inch of width of roller wheel, equipped with adjustable scrapers and means for keeping wheel wet to prevent mix from sticking
   2. Pneumatic-tired rollers: Self-propelled, contact pressure under each tire of 85 to 110 psi, wheels spaced so that one pass will accomplish one complete coverage equal to rolling width of machine, oscillating wheels. Remove and replace immediately tires picking up fines

C. Hand Tools: Provide rakes, lutes, shovels, tampers, smoothing irons, pavement cutters, portable heaters, and other miscellaneous small tools

3.07 PLACING THE MIX

A. Place asphalt concrete mixture on prepared surface, spread and strike-off using paving machine

B. Complete placement over full width of section on each day's run

C. Spread mixture at minimum temperature specified by CDOT Table 401-5 for the specific binder used in the asphalt mix:
   1. PG 64-22: 320 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
   2. PG 58-28: 275 F minimum mix discharge temperature, 235 F minimum delivered mix temperature
   3. The maximum mix discharge temperature will not exceed the minimum discharge temperature by more than 30 F.
   4. Delivered mix temperature will be measured behind the paver screed
   5. Hot asphalt mixture will be produced at the lowest temperature with the specified temperature range:
      a. producing a workable mix and provides for uniform coating of aggregates, in accordance with AASHTO T195
      b. allowing the required compaction to be achieved

D. Inaccessible and small areas may be placed by hand

E. Conform to the grade, cross section, finish thickness, and density indicated.

F. Lift Thickness
   1. Place in multiple lifts. Place asphalt in lifts such that each compacted lift thickness is no less than 2.0” thick and no greater than 3.0” thick. Top lift to be 2” thick.
   2. Typical Lift Thickness Sequencing:

Final Asphalt Section Required (inches)	No. of Lifts	Thickness of each Lift (inches) from bottom to top lift
2”	1	2
3”	1	3
4”	2	2-2
5”	2	3-2
6”	3	2-2-2
7”	3	3-2-2
8”	3	3-3-2
9”	4	3-2-2-2
10”	4	3-3-2-2
>10	Review with Engineer	

G. Paver Placing
   1. Unless otherwise directed, being placing along centerline of areas in crowned section and at high side on one-way slope and in direction of traffic flow
   2. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips
   3. Complete base courses before placing surface courses
   4. Place mixture in continuous operation as practicable

H. Hand Placing
   1. Spread, tamp, and finish mixing using hand tools in areas where machine spreading is not possible as acceptable to Engineer
   2. Place mixture at a rate that will insure handling and compaction before mixture becomes cooler than acceptable working temperature

I. Joints
   1. Construct transverse joint at right angles to centerline when operations are suspended long enough for mixture to chill

2. Construct joints to have same texture, density, and smoothness as adjacent sections of asphalt concrete course
3. Clean contact surfaces free of sand, dirt, or other objectionable material and apply tack coat
4. Offset transverse joints in succeeding courses not less than 24 inches
5. Cut back edge of existing pavement or previously placed course to expose an even, vertical surface for full course thickness
6. Offset longitudinal joints in succeeding courses not less than 6 inches
7. When the edges of longitudinal joints are irregular, honeycombed or inadequately compacted, cut back unsatisfactory sections to expose an even, vertical surface for full course thickness
8. Wearing course constructed in even number of strips; place 1 longitudinal joint on centerline of road
9. Wearing course constructed in odd number of strips; place the centerline of 1 strip on centerline of road

J. Gutter: Finish surface high adjacent to concrete gutter so when compacted surface is slightly higher than edge of curb and flashing

3.08 COMPACTING THE MIX

A. All paving will be compacted to 94 +/- 2% of Maximum Theoretical (RICE) density, CP-51 or AASHTO T209: Maximum Specific Gravity of Bituminous Paving Mixtures, as determined by ASTM D 2950. RICE values will be used in calculating Relative Compaction according to CP-44 or AASHTO T166.

B. Provide pneumatic and steel-wheel type rollers to obtain the required pavement density, surface texture and rideability

C. Begin rolling operations when the mixture will bear weight of roller without excessive displacement and complete as quickly as possible after placement occurs.

D. Compaction operations will be continuous until the required density is achieved or the density requirements are not met and the mix temperature falls below 185˚ F or there is obvious surface distress or breakage. Minimum compaction temperatures may be adjusted according to the asphalt binder supplier recommendations. Adjusted minimum compaction temperatures must be shown on the approved mix design or on the asphalt binder supplier documentation kept on file at the jobsite.

E. Do not permit heavy equipment, including rollers to stand on finished surface before it has thoroughly cooled or set

F. Compact mixture with hot hand tampers or vibrating plate compactors in areas inaccessible to rollers

G. Start rolling longitudinally at extreme lower side of sections and proceed toward center of pavement. Roll to slightly different lengths on alternate roller runs

H. Do not roll centers of sections first under any circumstances

I. Breakdown Rolling
1. Accomplish breakdown or initial rolling immediately following rolling of transverse and longitudinal joints and outside edge
2. Operate rollers as close as possible to paver without causing pavement displacement
3. Check crown, grade, and smoothness after breakdown rolling
4. Repair displaced areas by loosening at once with lutes or rakes and filling, if required, with hot loose material before continuing rolling

J. Second Rolling
1. Follow breakdown rolling as soon as possible, while mixture is hot and in condition for compaction
2. Continue second rolling until mixture has been thoroughly compacted

K. Finish Rolling
1. Perform finish rolling while mixture is still warm enough for removal of roller marks by combination of steel and pneumatic rollers
2. Continue rolling until roller marks are eliminated and course has attained specified density, and required surface texture and surface tolerances

3. After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened. Erect barricades to protect paving from traffic until mixture has cooled and attained its maximum degree of hardness

L. Patching
1. Remove and replace defective areas
2. Cut-out and fill with fresh, hot asphaltic concrete
3. Remove deficient areas for full depth of course
4. Cut sides perpendicular and parallel to direction of traffic with edges vertical
5. Apply tack coat to exposed surfaces before placing new asphaltic concrete mixture
6. Compact by rolling to specified surface density and smoothness

3.09 JOINING TO EXISTING WORK

A. Cut sides vertically and apply tack coat to exposed asphalt surfaces before placing new pavement. Meet existing thickness of surface and base courses, but not less than specified for new work.

B. All joins shall be compacted to 92.0% +/- 2.0% of RICE, taken fully on each side of joint, every 200 lineal feet. RICE values shall be used in calculating Relative Compaction according to AASHTO T166.

3.010 FIELD QUALITY CONTROL

A. The Owner will engage a certified testing agency to perform field testing to determine compliance of in-place asphaltic concrete paving materials and compaction in accordance with Division One Specifications.

B. It is the Contractor's responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide the testing agency contractually required, 24 hour, one business day advance notification to schedule tests.

C. Testing Agency will test in-place pavement for density and thickness.

D. Asphalt density testing:
1. Every one-hundred fifty (150) lineal feet per driving lane.
2. Every 2,000 square feet of parking lot
3. Densities shall be between ninety-two percent (92%) and ninety-six percent (96%) of the RICE unit weight

E. Contractor to verify final surfaces are of uniform texture, conforming to required grades and cross sections

F. The Contractor will core the pavement as required by the testing agency for field density tests in accordance with AASHTO T 230, Method B, or for field calibration of nuclear density equipment in accordance with ASTM D 2950.
1. Testing agency will take not less than 4-inch diameter pavement specimens
2. At the testing agency's discretion, cores may be required at the beginning of placement of each pavement layer or change of mixture materials or gradation.
3. Untested areas during placement will require cores to be taken to verify compaction
4. Contractor to repair holes from test specimens

G. For each completed course or from locations directed by the testing agency, and at a minimum, a representative asphalt pavement sample shall be taken from the first one thousand (1,000) tons, and all mix properties shall be verified. The percent voids filled with asphalt cement, Hveem stability, and Lottman shall be verified at a minimum of every ten-thousand (10,000) tons. Asphalt testing shall comply with ASTM D1559. Two copies of all test reports shall be submitted directly to the Engineer.

H. Acceptable density of in-place course materials is between 92 and 96 percent of the recorded laboratory RICE unit weight. Immediately re-compact asphaltic concrete not conforming to acceptable density. Remove and replace all sections not in conformance density requirements.

I. Thickness: Variations from drawings
   1. Base course: 1/4-inch +
   2. Remove and replace paving less than minimum thickness

J. Grade Tolerance: ±0.1 feet

K. Surface Smoothness
   1. Test using a 10-foot straight edge applied parallel to direction of drainage
   2. Advance straight edge five feet, maximum 1/4-inch per foot from nearest point of contact
   3. Do not permit pockets or depressions where water may pool
   4. Remove and replace areas, deficient in smoothness. Overlay corrections may be permitted only if acceptable to Engineer

L. Inspection: The work of this section is subject to the inspection and approval of the engineer and/or owner. The following inspections are required:
   1. Protection of adjacent property
   2. Staking and establishment of elevations
   3. Establishment and compaction of subgrade
   4. Placement and compaction of bituminous base course and wearing surface
   5. Final inspection
   6. Obtain approval of each element of work listed above in sequence of its completion before proceeding with the next item

M. After completion of paving operations, clean surfaces of excess or spilled asphalt materials to the satisfaction of Engineer

3.011 PROTECTION OF FINISHED WORK

A. After final rolling, do not permit vehicular traffic on asphalt concrete pavement until it has cooled and hardened and in no case sooner than 6 hours

B. Provide barricades and warning devices as required to protect pavement and the general public

3.012 WARRANTY

A. Provide installer's 2-year written warranty endorsed by the contractor warranting the pavement from creeping, shoring, cracking, softening, settling, ponding and other defects due to improper placing or defective materials. Replace defective materials upon notification by the owner in accordance with the requirements of the original work.

3.013 SCHEDULE OF MIX PLACEMENT:

A. Refer to Drawings for asphalt thickness and subgrade requirements.

B. Full Depth: 4-inch asphalt pavement

Composite: 2-inch asphalt over 6-inch aggregate base course.

END OF SECTION

SECTION 32 13 00
RIGID PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Forming, jointing, placing and curing of concrete pavements, curbs, gutters, cross pans, islands and sidewalks.

1.02 RELATED SECTIONS

A. Section 31 00 00 – Earthwork

1.03 REFERENCES

A. American Association of State Highway and Transportation Officials (AASHTO):
   1. AASHTO M171 – Sheet Materials for Curing Concrete

B. American Concrete Institute (ACI)
   1. 214 – Recommended Practice for Evaluating Compression Test Results of Field Concrete
   2. 301 – Specifications for Structural Concrete for buildings
   3. 304 – Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete
   4. 305/305R – Hot Weather Concreting
   5. 306/306R – Cold Weather Concreting
   6. 308 – Standard Practice for Curing Concrete

C. American Society for Testing and Materials (ASTM)
   1. A1064 – Carbon Steel Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete
   2. A615 – Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
   3. C31 – Making and Curing Concrete Test Specimens in the Field
   4. C33 – Concrete Aggregates
   5. C39 – Test Method for Compressive Strength of Cylindrical Concrete Specimens
   6. C94 – Ready Mix Concrete
   7. C143 – Test Method of Slump of Hydraulic Cement Concrete
   8. C150 – Portland Cement
   9. C260 – Air-Entraining Admixtures for Concrete
   10. C309/AASHTO M148 – Liquid Membrane-Forming Compounds for Curing Concrete
   11. C494 – Chemical Admixtures for Concrete
   12. C618 – Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
   13. C1116 – Fiber Reinforced Concrete
   14. D994 – Preformed Expansion Joint Filler for Concrete (Bituminous Type)
   15. D6690 – Joint and Crack Sealants, Hot Applied, for Concrete and Asphalt Pavements
   16. C979 – Pigments for Integrally Colored Concrete
   17. D1751 – Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction
   18. D1752 – Preformed Sponge Rubber Cork Expansion and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction
   19. D7508 – Polyolefin Chopped Stands for Use in Concrete

D. CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

E. Jefferson County construction specifications, standards and details.

1.04 SUBMITTALS

A. Provide under provisions of Division One Specifications

B. Product Data: Provide sufficient information on mix design and products specified to verify compliance with specifications. Provide data on joint filler admixtures and curing compounds
   1. Existing data on proposed design mixes, certified and complete
   2. Submit reports of field quality control testing

1.05 QUALITY ASSURANCE

A. Perform work in accordance with ACI 301, Conform materials and installation to applicable portions of Colorado Department of Transportation, and the Jefferson County construction specifications, standards and details.

1.06 REGULATORY REQUIREMENTS

A. For work on public streets or rights-of-way conform to the requirements of Jefferson County construction specifications, standards and details for the Construction of Curbs, Gutters, Sidewalks, Driveways, Street Paving, and other public right-of-way Improvements.

B. Comply with applicable requirements of CABO/ANSI A117.1 for accessibility requirements related to walks, ramps, parking areas, drives, curb ramps, etc.

C. Obtain cementitious materials and aggregate from same source for all work

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle materials under provisions of Division One Specifications

B. Reinforcing steel: Store on supports which will keep materials from contact with the ground and cover

C. Rubber and plastic materials: Store in a cool place, do not expose to direct sunlight

D. Prepare a delivery ticket for each load of ready-mixed concrete

E. Contractor shall submit tickets for all concrete delivered to site:
   1. Quantity delivered
   2. Actual quantity of each material in batch
   3. Outdoor temp in the shade
   4. Time at which cement was added
   5. Numerical sequence of the delivery
   6. Quantity of water that can be added in the field based on mix design
   7. Free moisture in fine and coarse aggregate in percent by weight
   8. Temperature of batch

1.08 ENVIRONMENTAL REQUIREMENTS

A. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen

B. Protect concrete from rapid loss of moisture during hot water placement

PART 2 PRODUCTS

2.01 MATERIALS

A. Form Materials
   1. Form Materials: Plywood: PS 1, waterproof resin-bonded, exterior type Douglas Fir; face adjacent to concrete Grade B or better
   2. Fiberboard: FS LL-B-810, Type IX, tempered, waterproof, screen back, concrete form hardboard
   3. Capable of supporting loads imposed by construction equipment, straight and free from warp. Clean and strong enough to resist pressure of concrete when placed and retain horizontal and vertical alignment. Coat forms with a non-staining form release agent that will not discolor or deface the surface of the concrete
   4. Joint filler: ASTM D1751 or D1752 type; 3/4-inch thick unless indicated otherwise

B. Reinforcement
   1. Where reinforcement is specified herein or indicated on the plans:
      a. Bars: ASTM A615, Grade 60
      b. Reinforcing Welded Wire Fabric (WWF): ASTM A1064, steel, 16 gage minimum
         i) Furnish in flat sheets
      c. Dowels: ASTM A615; 40 ksi yield, Grade 60, plain steel, unfinished finish
      d. Fibrous reinforcement: Collated, fibrillated, polypropylene fibers, tensile strength 70,000 psi
         i) ASTM C1116 and ASTM D7508

ii) Use minimum of 1.5 pounds per cubic yard
iii) Fibermesh or accepted substitution

C. Weed Control: First application, “Roundup.” Second application, Casoron “W-50" or “G-10” with colored marker dye, manufactured by Pacific Coast Borax Company or an accepted substitute of non-flammable type.

2.02 ACCESSORIES

A. Curing Compound: ASTM C309, AASHTO M-148, white pigmented liquid membrane

B. Joint Sealers: Polyurethane base, elastomeric, self leveling, chemical cure, handling 50% joint movement; Sikaflex-2C-SL or accepted substitutions

C. Sheet Materials: AASHTO M171, 4 mil

D. Expansion Joint Material: 0.5-inch thick, ASTM D1751, asphalt impregnated fiber board, glass fiber or sponge, or closed cell polyethylene foam; Texmastic “vinylex 3600,” Sonneborn “Sonoflex F,” or accepted substitutions
   1. FS TT-P-1952, Type I Alkyd, white, blue, yellow and red color paint meeting requirements of CDOT Standard Specification 708. Verify colors and extent of painting prior to painting. Unless noted on plans, evident at existing striping or instructed, provide white in color for traffic striping, parking stalls, and other control markings on internal pavement, yellow in color for traffic control markings or restricted parking or where indicated, blue in color for accessible parking stalls, and red in color for curbs where no parking is indicated. Reflectorized paint required for traffic stripes and control markings on internal drive, road or street pavements.
   2. Furnish paint with a no-pick-up maximum drying time of 20 minutes, when tested according to ASTM D711 using a wet film thickness of 0.015-inch when tested and applied at 77 degrees F.
   3. 3M Stamark 5730 preformed plastic marking material or an accepted substitute shall be used for crosswalks, stop bars, symbols (i.e. turn arrows) and striping for separation of turn and through lanes in right-of-way. Use of thermoplastic pavement marking is not permitted.

2.03 CONCRETE MIX

A. Comply with ASTM C94

B. Maximum Coarse Aggregate Size: 1-inch

C. Portland Cement: ASTM C150, Type II; 555 pounds minimum per cubic yard of concrete

D. Water/Cementitious Material (Cement and Fly Ash) Ratio: Less than or equal to 0.45

E. Slump: 4-inch maximum
   1. May be increased to 4.5 inches for hand work, acceptable to Engineer
   2. As low as possible consistent with proper handling and thorough compaction

F. Volumetric Air Content: 6.0%±2% after placement for 1-inch aggregate
   1. Vary air content with maximum size aggregate, ASTM C94, Table 3.

G. Strength: Compressive strength as determined by ASTM C39, 4,500 psi minimum at 28 days

H. Consistency: Uniform slump, suitable for the placement conditions with aggregate floating uniformly throughout the concrete mass, flowing sluggishly when vibrated or spaded

I. Adjust mix as required to meet specifications

J. Approved fly ash may be substituted for ASTM C150 cement up to a maximum of 25 percent Class C or Class F by weight of the cementitious material content. Fly ash for concrete shall conform to the requirements of ASTM C618 with the following exceptions:
   1. The loss on ignition shall not exceed 3.0 percent
   2. The CaO in Class F fly ash shall not exceed 18 percent

K. Admixtures: Content, batching method, and time of introduction in accordance with the manufacturer's recommendations for compliance with this specification
   1. Include a water reducing admixture
   2. Calcium chloride content shall not exceed 0.05% of the cement content by weight

2.04 SOURCE QUALITY CONTROL AND TESTS

A. Provide under provisions of Division One Specifications

B. Submit proposed mix design to Engineer for review prior to commencement of work

C. Tests on cement and aggregates will be performed to ensure conformance with specified requirements

D. Test samples in accordance with ACI 301.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads

B. Verify gradients and elevations of base are correct

C. Check completed formwork for grade and alignment to the following tolerances:
   1. Top of forms not more than 1/8-inch in 10 feet
   2. Vertical face on longitudinal axis, not more than 1/4-inch in 10 feet

3.02 PREPARATION

A. Subgrade
   1. Prepare subgrade in accordance with Section 31 00 00 – Earthwork
   2. Moisten subgrade to depth of 6 inches at optimal moisture not more than 12 hours prior to placement to minimize absorption of water from fresh concrete
   3. Check for soft spots by proof-rolling or other means prior to setting forms. Remove soft yielding material and replace. Compact to specifications under provisions of Section 31 00 00 – Earthwork.
   4. Check crown and/or elevation of subgrade to assure specified thickness. Compact to specification additional material used to bring to correct elevation. Remove excess material where subgrade is too high
   5. Clean subgrade of all loose materials before placement of concrete. Do not disturb area inside forms after fine grading is complete
   6. Weed Control:
      a. If weeds or vegetation exist at or on the subgrade, apply “Round-up” at rates following manufacturer’s instructions. Apply “Round-up” three days prior to removal of vegetation, subgrade preparation and application of Casoron as described below to allow “Round-up” to kill all vegetation. Remove all living and dead weeds, root balls, tree/shrub roots, vegetation, and/or any organic matter from on or in the subgrade per applicable earthwork specifications prior to subgrade preparation and paving at all areas to be paved.
      b. After all fine grading, checking, shaping, and compacting of the subgrade has been completed, and just prior to placing pavement, all subgrade soil in the area to receive pavement shall be thoroughly treated with Casoron soil sterilant (in addition to “Round-up” and regardless of presence of existing weeds or vegetation). Casoron shall be thoroughly sprinkled to distribute the chemical through the first two or three inches of the subgrade. For all areas to be paved, apply Casoron weed control at a minimum rate per 100 square yards of 2.4 pounds for G-10 or 4.0 pounds for 50w at rates and methods recommended by manufacturer within one day of paving.
      c. The Contractor shall provide all necessary protection to prevent injury to animal, fish, or plant life and property occasioned by the application of the soil sterilant. Apply on a calm, wind-free day. The Contractor will be held responsible for all application of soil sterilant or the storage of same. Protect existing and new trees and shrubs beyond the limit of paving from damage due to weed killer or soil sterilant overspray or root contact. Extra caution is required to prevent over-application of products in areas to be paved under tree canopies. Trees and shrubs damaged or killed by weed killer or sterilant application shall be replaced by the contractor at contractor’s expense.
      d. Do not apply within 20 feet of trees or shrubs

B. Frame Adjustment

1. Coat surfaces of manhole and catch basin frames with oil to prevent bond with concrete pavement for concrete collars
2. Set frames of structures in full grout bed to provide bearing. Set to final grade
3. Form construction joints and blockouts as indicated on drawings

3.03 PERFORMANCE AND INSTALLATION

A. Transporting mixed concrete
   1. Transporting of mixed concrete shall conform to ACI 305R
   2. Do not exceed manufacturer's guaranteed capacity of truck agitators. Maintain the mixed concrete in a thoroughly mixed and uniform mass during handling
   3. Do not incorporate additional mixing water into the concrete during hauling or after arrival at the delivery point, unless ordered by the Engineer. If additional water is to be incorporated into the concrete, revolve the drum not less than 30 revolutions at mixing speed after the water is added and before placing concrete.
   4. Furnish a water measuring device in good working condition, mounted on each transit mix truck, for measuring the water added to the mix on the site by the Engineer
   5. Provide delivery ticket and comply with delivery requirements of this section

B. Forming
   1. Place and secure forms to correct location, dimension, profile, and gradient
   2. Install sufficient quantity of forms to allow continuous progress of work so that forms can remain in place at least 24 hours after concrete placement
   3. Join neatly and mechanically tamp to assure firm placement. Assemble formwork to permit easy stripping and dismantling without damaging concrete
   4. Oil forms prior to concrete placement
   5. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement
   6. Set dowels, expansion joints, preformed construction joints and header boards as specified or indicated on the drawings
   7. Low roll or mountable curbs may be formed without the use of face form by using a straight edge and template to form curb face
   8. Backfill behind forms as required to prevent water from entering subgrade

C. Reinforcement
   1. Add fiber reinforcement to mix at plant prior to delivery to jobsite. Mixing shall be as recommended by the manufacturer to distribute the product evenly throughout the concrete mix
   2. Place bar or WWF reinforcement at mid-height of slabs-on-grade or as shown on the drawings
      a. Install in as long lengths as possible. Lap adjoining pieces at least one full mesh and lace with wire
      b. Support with metal chairs, brick or stone is unacceptable
   3. Hold all tie and marginal dowels in proper position by sufficient supports or pins
   4. Mechanically install dowels or place on supports if center longitudinal joint is sawed in lieu of placing plastic strip
   5. Interrupt reinforcement at expansion joints
   6. Place dowels to achieve pavement and curb alignment as detailed.
   7. Provide doweled joints inch at interruptions of concrete with one end of dowel set in capped sleeve to allow longitudinal movement
   8. Grease dowels on one side of joints with caps on greased end

D. Placing concrete
   1. Place concrete in accordance with ACI 301
   2. Lightly moisten subgrade or base course immediately before placing concrete.
   3. Ensure reinforcement, inserts, embedded parts, and formed joints are not disturbed
   4. during concrete placement
   5. Deposit concrete near final position. Minimize segregation and damage to subgrade
   6. Place concrete continuously over the full width of the panel and between predetermined construction joints. Spread mechanically to prevent segregation and separation of materials

7. Consolidate concrete with vibrators and spade next to forms to remove air spaces or honeycombs
8. Do not place concrete in forms that has begun to set
9. Do not place more concrete in one day than can be finished before dark the same day
10. Curbs and Gutters: Automatic machine may be used for curb and gutter placement at Contractor's option. If machine placement is to be used, submit revised mix design and laboratory test results which meet or exceed minimums specified. Machine placement must produce curbs and gutters to required cross-section, lines, grades, finish, and jointing as specified for formed concrete. If results are not acceptable, remove and replace with formed concrete as specified
11. Walks: Construct sidewalks with a minimum thickness of 4-inch. Tool edges to rounded profile and finish as specified or as shown on the drawings. Pitch walks 1/4-inch per foot for cross drainage unless otherwise indicated

E. Cold weather concreting
1. Conform to ACI 306/306R, except as modified herein
2. Minimum concrete temp at the time of mixing

Outdoor Temp at Placement (in shade)	Concrete Temp at Mixing
Below 30°F	70°F
Between 30°F & 45°F	60°F
Above 45°F	45°F

3. Do not place heated concrete which is warmer than 80 degrees F
4. If freezing temp are expected during curing, maintain the concrete temp at or above 50 deg F for 5 days or 70 deg F for 3 days with forms in place
5. Do not allow concrete to cool suddenly

F. Hot weather concreting
1. Conform to ACI 305/305R, except as modified herein
2. At air temp of 90 degrees F and above keep concrete as cool as possible during placement and curing. Fog sprayers or special wetting agents may be required for protection
3. Do not allow concrete temperature to exceed 70 deg F at placement
4. Prevent plastic shrinkage cracking due to rapid evaporation of moisture
5. Do not place concrete when the actual or anticipated evaporation rate equals or exceeds 0.2 lbs per sq ft per hr as determined from ACI 305, Fig 2.1.4

G. Joints
1. Provide concrete joints per CDOT Standard Details
2. Sidewalk and pavement
   a. Contraction joints: At intervals not to exceed 10 feet and 1 1/2 inches deep, tooled or sawcut
   b. Expansion joints: 1/2-inch premolded joints where sidewalks end at curb returns, against fixed objects, at points of sharp radius, and between sidewalk and driveway slabs. Place expansion joint at minimum of every 100 feet.
   c. Construction joints: At all separate pours, and around all appurtenances such as manholes, utility poles, and other penetrations extending into and through sidewalks. Place backer rod and polyurethane sealant for entire joint length
3. Curb and Gutter
   a. Contraction joints: At intervals not to exceed 10 feet made by insertion of 1/8-inch template at right angles to curb and 1 1/2-inch deep.
   b. Expansion joints: At curb returns, against fixed objects, at points of sharp radius, between adjacent sidewalk and curb at all curb returns, between sidewalk and all driveway slabs, and along straight lengths every 200 linear feet. Install expansion joint filler between concrete sidewalks and any fixed structure. Extend expansion joint material for full depth of concrete, except stop 1/2-inch below finish surface.

c. Construction joints: At all separate pours, place backer rod and polyurethane sealant for entire joint length.

4. Place expansion joint filler between paving components and buildings or other appurtenances at temperatures above 50 deg F. Clean all dust, debris and water from joint. Recess top of filler 1/2-inch for sealant placement.
5. Provide keyed joints as indicated in details.

H. Finishing
1. Run straight-edge over forms with sawing motion to fill all holes and depressions.
2. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.
3. After floating, test surface for trueness with a 10' straightedge. Distribute concrete as required to remove surface irregularities, and re-float repaired areas to provide a continuous smooth finish
4. Finish surfaces with a wooden or magnesium float. Plastering of surfaces is not permitted
5. Immediately after float finishing, slightly roughen the concrete surface by brooming in the direction perpendicular to the main traffic route. Use fine hair fiber-bristle broom unless otherwise directed. Coordinate the required final finish with the Engineer before application.
6. On inclined slab surfaces and steps, provide a coarse, non-slip finish by scoring surface with a stiff-bristled broom, perpendicular to line of traffic
7. Edge all outside edges of the slab and all joints with a 0.25-inch radius edging tool.
8. Work edges of gutters, back top edge of curb, and formed joints with an edging tool, and round to 0.5-inch radius, unless otherwise indicated. Eliminate tool marks on concrete surface
9. Brush with soft bristle brush to remove trowel marks and leave a uniform appearance just before concrete takes initial set.
10. Direction of Texturing:
    a. Curb and Gutter: At right angles to the curb line
    b. Sidewalk: At right angles to centerline of sidewalk.
11. Place curing compound on exposed concrete surfaces immediately after finishing. Apply under pressure at the rate of one gallon to not more than 135 square feet by mechanical sprayers in accordance with manufacturer's instructions acceptable to Engineer.

I. Joint sealing
1. Seal joints and clean concrete prior to opening to traffic.
2. Seal all expansion joints.
3. Separate concrete from other structures with 3/4-inch thick joint filler.
4. Place joint filler in concrete pattern placement sequence. Set top to required elevations. Secure to resist movement by wet concrete.
5. Extend joint filler from bottom of pavement to within 1/4-inch of finished surface.

J. Curing and protection
1. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury
2. Have plastic sheeting, straw, burlap and/or canvas materials available at all times to protect fresh uncured surfaces from adverse weather conditions
3. Do not permit pedestrian traffic over sidewalks for 7 days minimum after finishing. Do not permit vehicular traffic over pavement for 14 days minimum after finishing or until 75 percent design strength of concrete has been achieved

3.04 FIELD QUALITY CONTROL

A. Comply with Division One Specifications - Quality Assurance: Field inspections and testing

B. It is the Contractor’s responsibility to initiate, coordinate and accommodate all required tests and inspections including conformance with requirements of all applicable public agencies and authorities. Contractor will be responsible for coordinating the testing requirement with testing agency and provide testing agency contractually required, 24 hour, one business day advance notification to schedule tests.

C. Tolerances
   1. Division One Specifications - Quality Assurance: Tolerances
   2. Maximum Variation of Surface Grade: 1/4- inch in 10 ft
   3. Maximum Variation from True Alignment: 3/8-inch in 10 ft

D. Take cylinders and perform slump and air entrainment tests as required by Division One Specifications in accordance with ACI 301. Unit weight and mix temperature will also be taken

E. The first three loads will be tested for slump and air content. If any one test fails to meet requirements, that load will be rejected and tests will continue on each load until three consecutive loads meet requirements. Thereafter, five concrete test cylinders will be taken for every 75 cu yds or less cu yds of concrete placed each day

F. One additional test cylinder will be taken during cold weather and cured on site under same conditions as concrete it represents

G. One slump and air entrainment test will be taken for each set of test cylinders taken

H. Cylinders will be tested as follows: 2 at 7 days, 2 at 28 days and one at a later date, if necessary, as directed by the Engineer

I. Maintain records of placed concrete items. Record date, location of pour, quantity, air temperature, and test samples taken

J. Thickness of fresh concrete may be checked by Owner at random. Coring will be conducted in accordance with Jefferson County requirements. Where average thickness of concrete is deficient in thickness by more than 0.20-inch, but not more than 1.0-inch, payment to Contractor will be adjusted based on amount indicated in schedule of values for portland cement concrete paving as specified in the following table.

CONCRETE PAVEMENT DEFICIENCY	
Deficiency in Thickness (Determined by Cores) INCHES	Proportional Part of Contract Price Allowed
0.00 to 0.20	100%
0.21 to 0.30	80%
0.31 to 0.40	72%
0.41 to 0.50	68%
0.51 to 0.75	57%
0.76 to 1.00	50%
Over 1.00	NONE

Note: When thickness of pavement is deficient by more than one inch, and judgment of the Engineer is that area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

K. Failure of Test Cylinders or Coring Results: Engineer may order removal and replacement of concrete as required upon failure of 28-day tests or if thickness of pavement is less than 95% of specified thickness

3.05 SCHEDULE OF CONCRETE

A. See plans for concrete thicknesses and subgrade preparation.

3.06 SCHEDULE OF CONCRETE REINFORCEMENT

A. Fiber reinforcement required for all concrete flatwork, including curb and gutter, sidewalk and pavement

B. Rebar reinforcement required for all cross pans.

C. Trash pad, dumpster locations and other locations shown on plans as heavy duty concrete: 8-inch thick concrete with #4 rebar, 12-inches on center, each way, three inches clear on all sides

END OF SECTION

SECTION 32 3113
CHAIN LINK FENCES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Drawings and general provisions of the Contract, including General and Supplemental Conditions and Division 01-Specification sections, apply to work of this section.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Chain link fencing as shown on the drawings for site fencing.

B. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 SUBMITTALS

A. Submit manufacturer's technical data, shop drawings and installation instructions for metal fencing.

1.04 QUALITY ASSURANCE

A. Provide chain link fences as complete units produced by a single manufacturer including necessary erection accessories, fittings, fastenings and gates.

B. Except where higher standards are indicated conform to "Product Manual" published by CLMFI for materials and ASTM F567 for installation.

PART 2 PRODUCTS

2.01 STEEL FENCING

A. Fence Fabric: No. 9 ga. (0.148") steel wires, 2" mesh at perimeter fence, 1 ¾" for backstop and 1" for ECE fencing, with both selvages knuckled.
   1. Furnish one-piece fabric widths for fencing up to 12' high.
   2. Fabric finish, galvanized, ASTM A392, Class I, with not less than 1.2 oz. zinc per sq. ft.

B. Framework: Galvanized steel, ASTM A120, with not less than 1.8 oz. zinc per sq. ft. for galvanized fence.

C. Hardware and Accessories: Galvanized, ASTM A153, with zinc weights per Table I for galvanized fence.

2.02 FRAMING AND ACCESSORIES

A. Space as shown on plans and sections.

B. Not used.

C. For 4", 6', 8', or 10' chain link – 1.66" OD steel pipe, 2.72 lbs. per linear foot. All top rails to be minimum 20' lengths.

D. Line Posts: For 4', 6', or 8'– 2.5" OD steel pipe, 3.65 lbs. per linear foot.

E. Terminal Posts: All fence posts to be 2.875' OD steel pipe. Post to be Schedule 40.

F. Backstop Framework: Line and End Posts 4" OD steel pipe. Top rails 2.875" OD. Steel pipe. Intermediate and Bottom Rails 1.66" OD steel pipe. Fabricated with welded joints.

G. Backstop Boards: Provide 2"x6" solid composite lumber boards along bottom of backstop, as hown on backstap detail. Bolt per details. Countersink nuts and file smooth.

F. Horizontal Center Rail and Mid Rail: For 6' height chain link fencing and above – 1.66" OD steel pipe, 2.27 lbs. per linear foot.

G. Bottom Rail: 1.66" OD steel pipe, 2.27 lbs per linear foot.

H. Gate Posts: Single gates up to 6' – 2.875" OD. Double gates and gates over 6' – 3.5" OD.

I. Truss Rods: 3/8” diameter with anchor and turnbuckle.

J. Gate Frames: 1.9” OD with limiters at all sport court gates.

K. Tension Wire: 9-gauge galvanized steel. Locate at bottom of fabric and 24” above bottom edge of fabric. Weave continuous strand between terminal posts for entire length.

L. Wire Ties: For tying fabric to posts and rails, use 9-gauge steel wire ties spaced 12" o.c. For tying fabric to tension wire, use hog rings spaced 24" o.c. Galvanized or powder coated to match fence fabric.

M. Manufacturer's standard procedure will be accepted if of equal strength and durability. Check with Landscape Architect prior to beginning work.

N. Post Brace Assembly: Manufacturer's standard adjustable brace at both sides of corner and pull posts, with horizontal brace located at mid-height of fabric.

O. Horizontal Brace: Use 1.66" OD pipe.

P. Post Tops: Weather tight die cast aluminum closure cap with loop to receive top rail, one cap for each post

Q. Stretcher Bars and Bands: One piece stretcher bars in lengths equal to full height of fabric, with minimum cross-section of 0.188" x 0.75". Provide one stretcher bar for each gate and end post, and 2 for each corner and pull post, except where fabric is integrally woven into post.

R. Space stretcher bar bands not over 12" o.c., to secure stretcher bars to end, corner, pull, and gate posts.

S. Concrete: Provide concrete consisting of Portland cement, ASTM C150, aggregates, ASTM C33, and clean water. Mix materials to obtain concrete with a minimum 28-day compressive strength of 2500 psi, using at least 4 sacks of cement per cu. yd., 1" maximum size aggregate, maximum 3" slump, and 2% to 4% entrained air.

T. Refinishing: Following any damage to post coating, immediately refinish with two coats of Rustoleum aluminum paint at galvanized fencing, or paint per manufacturer’s recommendation at powder coated fencing to match original finish.

U. Gate Accessories: Industrial malleable iron ball and socket hinge. Integral padlock eye. Operable from either side. Malleable gate fork latch for single gates. Industrial latch pressed steel latch assembly for double gates including plunger rod. Industrial gate ells for double gates. 180 degree swing.

V. Panic Hardware: Detex V40 Surface Mounted Weather Resistant Exit Bar with 24” Mounting Plate, Outside Trim Kit with Lever Handle and Lock with Keyed Cylinder , Gate Latch Projector and stainless steel fasteners and hardware by DAC Industries, or approved equal. Color to be black. Qty (2). Gate Closer by Truclose, self-closing mechanism.

W. Gate Latches:
1. Padlock eye
2. Operation either side
3. Single gate: Fork type
4. Double gate: Cane bolt/drop pin assembly mounted to gate, vertical frame, designed to engage strike/ground sleeve that is embedded 18” minimum in concrete (inactive leaf)
5. Weld in place. Bolt or screw attachment of latches is prohibited.

PART 3 EXECUTION

3.01 INSTALLATION

A. Do not begin installation and erection before final grading is completed, unless otherwise permitted.

B. For fencing attached to concrete, do not begin work before these materials have been completed, cured and have attained their design strengths.

C. Excavation: Drill holes for post foundations of diameters and spacing shown, in firm, undistributed or compacted soil.

D. Framework: Setting Posts: Center and align posts in holes 3" above bottom of excavation.

E. Place concrete around posts and vibrate or tamp for consolidation. Check each post for vertical and top alignment, and hold in position during placement and finishing operations. Bring top elevation of concrete to 5" below pavement grade except where otherwise shown and trowel smooth with wash away from post.

F. Pour curb or mow strip to grade indicated. Trowel smooth. Clean posts. Cut one perpendicular control joint to the center of each post.

G. Top Rails: Run rail continuously through post caps. Weld linear connections as recommended by fencing manufacturer. Do not use couplings at backstop.

H. Center Rails: Provide center rails only where shown. Install in one piece between posts and flush with post on fabric side, using special offset fittings where necessary.

I. Brace Assemblies: Install braces so posts are plumb when diagonal rod is under proper tension.

J. Truss Rods: Install diagonally from top of all terminal posts to bottom of nearest line post and diagonally each way on gates.

K. Gate Frames: Welded construction only.

L. Tension Wire: Install tension wires by weaving through the fabric and tying to each post with not less than 9-gauge galvanized wire, or by securing the wire to the fabric. Twist two turns and bend to prevent hazard.

M. Fabric: Pull fabric taut and tie to posts, rails, and tension wires. Install fabric on security side of fence, or on the active side for playfields, and anchor to framework so that fabric remains in tension after pulling force is released. Maintain 2" clearance to grade.

N. Stretcher Bars: Thread through or clamp to fabric 4" o.c., and secure to posts with metal bands spaced 12" o.c.

O. Tie Wires: Use U-shaped wire, conforming to diameter of pipe to which attached, clasping pipe and fabric firmly with ends twisted at least 2 full turns. Bend and put wire to minimize hazard to persons or clothing. Leave no ends exposed past fabric thickness.

P. Fasteners: Install nuts for tension bands and hardware bolts on side of fence opposite fabric side. Peen ends of bolts or score threads to prevent removal of nuts; file smooth.

Q. Latches: Set double gate plunger bar strike in concrete.

R. Curved fence sections: For fence sections installed on radii, post spacing may need to be closer to create and accommodate curve. Do not bend rails.

END OF SECTION

SECTION 32 84 00
IRRIGATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Underground Sprinkler System.

B. Installation.

C. Testing.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide underground sprinkler system as a complete unit produced by manufacturers indicated on drawings, including heads, valves, piping circuits, controls, and accessories.

B. Installer Qualifications: Have satisfactorily installed acceptable underground sprinkler system(s) on at least three other projects of comparable complexity.

C. Irrigation Drawings: The irrigation drawings are essentially diagrammatic. Due to the scale of the drawings, all characteristics of the system (i.e., sleeving, fittings, etc.) may not be represented. The Contractor shall carefully inspect the site and plan his work accordingly, supplying materials and equipment necessary to install said characteristics.

The Contractor shall notify Landscape Architect of discrepancies of site dimensions, obstructions, etc. that were not shown on the drawings and that might not have been known during preparation of irrigation drawings. If such notification is not made, Contractor shall assume all expenses and responsibility for revisions necessary. Work called for on the drawings by notes or on details shall be furnished and installed whether or not specifically mentioned in the specifications.

Design locations of heads, valves and lines are approximate. Contractor shall make minor adjustments of locations to avoid obstacles. Contractor to flag head locations and chalk pipelines. Adjustments or additional heads due to trees, lights, or other obstacles will be approved by Owner and Landscape Architect prior to work. Finish grades shall be approved prior to installation of the irrigation system.

D. Ordinances and Regulations: Contractor shall observe state and local laws, ordinances and regulations concerning the materials and installation of the irrigation system.

1.04 SUBMITTALS

A. As-Built or Record Drawings/Maintenance Manual: Acceptance of the system is based on the furnishing by the contractor of a complete as-built plan showing exact location of all mainline and valves and any changes in location of sprinkler heads, piping, etc. which is acceptable to the Owner's Representative. Record dimensioned locations and depths for each of the following. Locate all dimensions from two permanent reference points (building, monuments, sidewalks, curbs or pavements). Make dimensions accurately at the same scale used in the original drawings, or larger. Notes and dimension lettering must be legible.

1. Point of connection.
2. Gate valves.
3. Sprinkler control valves.
4. Quick coupling valves.
5. Wire splice boxes.
6. Other related items as may be directed by the Landscape Architect.
7. Sleeving locations, sizes and depths.

Contractor shall furnish to the Owner a mylar plot of irrigation system, and two laminated 11" x 17" reductions of the drawings, product cut-sheets and operation instructions for same, and complete maintenance instructions, including system winterization and start-up procedures, all neatly assembled in plastic sheet covers into one hard-cover three ring notebook with project name on cover. Also provide:

8. Two manual drain valve keys, 6’ long with tee handle.
9. Two quick coupler keys with hose swivels and 3/4" adapters.
10. Two Automatic controller keys.
11. Two valve box keys.
12. Two gate valve keys, 6’ long with tee handle.
13. Two of each type of head installed on project.
14. Two keys/tools for valve box bolt removal.

B. Quality Control Submittals: Deviations from the proposed irrigation design must be approved by the Landscape Architect prior to construction. Submit three (3) copies of design deviations before commencing any work.

C. As of the date of Final Acceptance for the entire project, the Owner shall be solely responsible for setting of irrigation controllers. Within three calendar days of the date of Final Acceptance, the landscaping subcontractor shall provide in writing, the program of existing irrigation settings for the entire season, and other information necessary to the proper operation of the irrigation system.

During the warranty period for the project, the landscape subcontractor may inspect the clock to review controller settings. If, as a result of a landscape subcontractor’s inspection, adjustments to those settings are necessary, the landscaping subcontractor shall notify the Owner, in writing, as to when the settings were inspected, what specific changes are recommended, and why. The landscape subcontractor shall not make any changes to the irrigation settings during the two-year warranty period. If, in the opinion of the Owner, the changes are necessary, the Owner will make the changes to the clock and controller settings and notify the landscape subcontractor in writing of the change. The Owner shall also notify the landscape subcontractor in writing if the Owner determines that the recommended changes are not necessary and the basis for this determination. If the landscaping subcontractor makes changes to the irrigation control settings during the warranty period, the landscaping subcontractor assumes full financial responsibility for damage and loss that occurs as a result of those changes. During the warranty period, the Owner shall notify the landscaping subcontractor, in writing, whenever the Owner makes adjustments to irrigation control settings. If no written notification is provided to the landscaping subcontractor by the Owner, Owner shall assume full financial responsibility for any damage and loss that occurs as a result of those changes.

D. Product data: Submit manufacturer’s technical data for each item to be installed.

1.05 WARRANTY

A. Warranty: During the period of two full years after the final payment of work, make all necessary repairs or replacements due to defective workmanship or materials within two (2) calendar days of receipt of notice of malfunction by the Owner.

1.06 PROTECTION OF PROPERTY AND SAFETY MEASURES

A. Property and Utilities: Trees, shrubs, flowers, fences, buildings, walks, roadways, and other property shall be protected from damage. Damage to said property shall be repaired or replaced to the Owner's satisfaction at the Contractor's expense. Open trenches left exposed shall be flared and barricaded as per OSHA regulations by the Contractor. Contractor shall restore all areas to their original condition. Contractor shall be responsible to contact utility companies and the Landscape Architect for staked locations of all utilities on the property. If staked utilities are damaged by the Contractor, the utilities shall be repaired at the Contractor's expense.

All trenching and other work within dripline of existing trees shall be done by hand so as not to damage tree roots or limbs. Trenches shall be no less than one foot from the trunk of any tree. Promptly notify Landscape Architect of unexpected sub-surface conditions. No trenching shall be left open overnight.

B. Replacement of Paving and Curbs: Damage caused by trenching, crossing existing and/or proposed roadways, paths, curbing, etc. shall be kept to a minimum and damaged areas shall be restored to their original condition. This will include compaction of subgrade to 95% relative compaction.

Restoration shall take the following course:

Match existing paving sections for asphalt paving. Thoroughly compact sub-base, base course, and bituminous course, matching grade of existing paving. No rough or rolled grades will be allowed.

Blacktop curbs - hot mix bituminous curb mix tamped and shaped to match adjoining curbs.

Concrete paving - concrete to match adjoining concrete work, with control joints.

Sidewalks - concrete to match adjoining concrete work.

C. All existing irrigation systems shall not be offline for longer than 24 hours. This includes breaks, repairs, isolated zones, etc.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, those specified on irrigation drawings.

2.02 MATERIALS

A. Water Supply Lines: Under 3" Type K, rigid; solder weld fittings ASTM B88 (include pipe through backflow preventer).

B. Main Lines: Lines under continuous pressure shall be PVC.
   1. Mainline Pipe: Shall be Polyvinylchloride (PVC) pipe, ASTM D2241 or commercial standard CS256, Type 1, normal impact, Class 200 (SDR21) as applicable. It shall be continuously and permanently marked as to grade and manufacturer. Gasket fitting type is prohibited, no bell end pipe allowed. Contractor may have bell end pipe delivered to site and have bell ends cut off prior to installing. Thrust blocking is required.
      a. Provide High-Density Polyethylene (HDPE) DR-9 mainline where indicated on plans. Manufactured in accordance with AWWA C901/C906, ASTM D2239, ASTM D2737, ASTM D3035, ASTM F714 and ANSI/NSF 14/61 listed.
   2. PVC Fittings: Schedule 40 molded, solvent weld type PVC.
   3. Solvent: Primer/Cleaner and heavy bond cement conforming to ASTM D-2564.

C. Branch Lines: Lines not under continuous pressure shall be PVC .
   1. Polyvinylchloride (PVC) Pipe: Must meet requirements as set forth in commercial standard CS256, Type 1, or ASTM D2241, normal impact Class 160 (SDR 26) as applicable. No bell end pipe allowed. Contractor may have bell end pipe delivered to site and have bell ends cut off prior to installing.
   2. Joints: Plastic pipe joints shall be molded as the pipe and shall be suitable for solvent weld.
   3. Fittings: Plastic pipe fittings shall meet all the requirements of ASTM D2241 for Type 1, Grade PVC. Pressure rating and types of pipes shall be compatible with the pipe being used.
   4. Solvent: Primer/Cleaner and heavy bond cement conforming to ASTM D-2564.

D. Sleeving Pipe: PVC Pipe, class 200. Sleeves to be at least 2 nominal pipe sizes larger than line carried. Wiring shall be sleeved separately in 4" minimum pipe.

E. Valves: Manufacturer's standard, of type and size indicated on irrigation plans, and as follows:
   1. Electric Control Valves: In-line with manual flow adjustment. Include Pressure regulator and gauge (if specified). Include plastic ball valve per detail. Brand valve box cover with SV # and corresponding zone on time clock with 1" minimum letters.
      a. Acceptable Manufacturers:
         1) RainBird EFB-CP

2. Key operated mainline valves: Cast iron or bronze, rated to 150 psi min. Manual main resilient seated valve, gate type, with 2" square nut top. Brand valve box covers with 'GV' in 1" min. letters containing gate valves.
    a. Acceptable Manufacturer:
        1) Matco
        2) NIBCO
    b. Furnish 1 key (manual cross handle).
3. P.V.C. Swing Joints: Install quick couplers and rotary heads on P.V.C. double swing joints. Assemble by using three (3) schedule 80 elbows and four (4) schedule 80 nipples (3-3" nipples and 1-12" nipple). The male threaded nipples need to be wrapped with teflon tape. No prefabricated swing joints allowed. No Marlex street ells are allowed.

F. Sprinkler Heads:
1. Hi Pop-up Spray Heads:
    a. Body: Non-corrosive Cycolac plastic body, 1/2" Female I.P.S. threads.
    b. Nozzle: plastic
    c. Stainless steel nozzle-adjustment screws.
    d. Positive stainless-steel spring retraction.
    e. Pop-up projection shall be no less than 4". 12" for shrub, flower, and ground cover areas.
    f. Acceptable Manufacturers:
        1) RainBird 1800 Series.
2. Pop-up Rotary Gear Driven Heads:
    a. Body: High impact plastic.
    b. Drive: Sealed, oil packed gear assembly.
    c. Cover: rubber cover kit.
    d. Stainless steel retraction spring.
    e. Adjustable radius.
    f. Stainless steel riser.
    g. Acceptable Manufacturers:
        1) Hunter I-25 Series, I-20 Series.

G. Quick Coupling Assemblies:
1. Quick Coupling Valves: 2-piece all brass construction with locking rubber covers.
    a. Provide: RainBird 44LRC.
2. Coupler Keys:
    a. Provide coupler keys and hose swivels for each site as noted in this specification.
    b. Brass construction, heavy duty, double lug type.

H. Valve Box: Provide extensions. Provide 3" deep gravel sump for each box. Allow no space where soil can invade box or sump. Use jumbo boxes for any control valve.
1. Provide Highline Access Boxes with locking cover.
    a. Use jumbo, standard and 10” round sizes. No 6” or econo boxes allowed.
    b. Provide all locking bolts for lids.
2. Valve Box Branding: Letter and number size shall be no smaller than 1 inch and no greater in size than 2 inch. Depth of branding shall be more than 1/8 inch into valve box lid. Brand the box identification number with characters from the “Brand New Industries Inc.” value box branding kit. No hand lettering/branding allowed. Boxes shall be branded as indicated on the drawings.
3. Drainage Backfill: Clean gravel or crushed stone, graded from 1-1/2" maximum to 3/4" minimum. Allow no contact with soil.

I. Rain Gauge: Adjustable setting type.
1. Provide Rain Sensor per drawings. No substitutions.

J. Drainage Backfill: Clean gravel or crushed stone, graded from 1 1/2" maximum to 3/4" minimum.

K. Root Watering System
1. Acceptable manufacturer: Rainbird, RWS series.

2.03 AUTOMATIC CONTROL SYSTEM:

A. Hunter Controller; No Substitutions. (not required for this project)

B. General:
   1. Hard wired (not plug-in) with integral surge protection.
   2. 8 to 48 station capacity.
   3. Security code access.
   4. Weatherproof enclosure.
   5. 24 volt; stepped down immediately before the timer.
   6. Solid state microprocessor type with digital readout.

C. Display: On front panel of control unit and through an EIA standard RS-232-C port for on site or remote downloading of:
   1. Current Moister level.
   2. 31-day history reporting
      a. Program parameters
      b. Moisture levels.
      c. Watering activity in both time and volume.
      d. Error log.
   3. Bookkeeping feature including a log of up to 100 of the last manual input events (program changes, moisture setting changes, etc).

D. Operation: Capable of either stand-alone, remote, or network operation as follows:
   1. Scan each station and use moisture sensor data as its primary water application criterion.
   2. Provide, without additional wiring, an application of irrigation water to a follower station each time its assigned leader station has an application of irrigation water.
   3. Through peripherals, monitor electrical, flow, and sensor problems in the field and react appropriately.
   4. Capable of operating without respect to sensor reading from input at the control unit and without additional wiring.
   5. System networking option that allows control and data transfer (in either IBM or Macintosh format) with a central computer and networking of multiple automatic controllers using commercially available communications software through non-dedicated telephone lines.
   6. Immediate repeat cycle option.
   7. Automatic stat at any hour capability.
   8. Accurate incremental station timing from 2 to 60 minutes.
   9. Capable of manual shutdown, advance, or start any or all stations without affecting programming.
   10. Built-in pump start circuit relay (if necessary), U.L. listed reset circuit breakers.

E. Programming
   1. Four standard automatic programs that allow use of couplers without triggering a flow error or require operation of master valves and with the following capabilities:
      a. Up to 23 hour 59 minute watering window.
      b. Independent window open and close times.
      c. Allow continuous scanning of active stations during the watering window.
      d. Option to use or not use moisture sensor input.
      e. 3 optional exception periods during the watering window that will disallow watering during the exemption period and resume program operation when the exemption period is over.
      f. Allow simultaneous and overlapping program operation.
   2. Syringe program with the following capabilities:
      a. Independent start time.
      b. Variable station run times that apply individually to each station in the syringe program.
      c. Duration time equal to the sum of run times of the stations in the program.
      d. Water each station in the program once, in any sequence.
   3. Quick coupler program with the following capabilities:
      a. No station assigned.
      b. Independent calendar for legal watering days.

c. Independent start and stop times.
d. Independent allowable flow valve.

4. User programmable for simultaneous operation of 1 to 3 stations and the following independent station settings:
   a. Assignment to none, one, or more programs.
   b. High and low moisture levels.
   c. High and low flow values.
   d. Run time.
   e. Minimum soak time.
   f. Total station watering time per window.
5. Controller adjustable moisture settings for leader stations without a third wire to sensor.
   a. High value above which the station will not water.
   b. Low value that the station must reach before it will allow further watering.
   c. Convey bypassed watering cycle information to central computer.

F. Identification of and response to special situations as follows:
   1. Electrical problems such as wiring breaks, shorts, or bad solenoids.
   2. Sensor malfunction.
   3. Excessive or inadequate water flow during active irrigation cycle.
   4. Unauthorized water flow during inactive cycle.

G. Control:
   1. Peripheral equipment of other manufacturers.
   2. Permit economical retrofit of existing automatic systems to central control.
   3. Control either normally open or normally closed 24-volt master valves.
   4. Interface to monitor water flow readings from an appropriate electronic pulsing flow meter.
   5. Ability to control an auxiliary irrigation water pump through a 24-volt control or dry contact switch with an independent power supply.

H. Control Wiring: No. 14 or heavier single strand direct burial insulated copper wire AWG, or PE UL approved and sized as recommended by controller manufacturer. 12 gauge for runs above 1000 lineal feet. Provide connectors, accessories as required. Provide with color coded insulation to differentiate function and circuit. Furnish wiring diagrams showing color coding. If number of valves prohibits color coding, provide black positive wires and white grounds. Provide four extra positive (red) and one extra ground wire (yellow) entire length of main. Multi strand wire is prohibited.

PART 3 – EXECUTION

3.01 SYSTEM DESIGN

A. Design Pressures: As indicated on Irrigation Drawings, at connection to main pipe and at last head in circuit. Contractor to verify existing pressure prior to starting work. Provide existing pressure readings in writing to Owner. All discrepancies shall be resolved and approved by the Owner prior to construction.

B. Location of Heads: Design location is approximate. Make minor adjustments to avoid plantings and other obstructions. Flag head locations for approval before installation.

C. Minimum Water Coverage:
   1. Turf Areas: 100% minimum
   2. Other Planting Areas: 100% or as indicated on drawings.

3.02 TRENCHING AND BACKFILLING

A. General: Excavate straight and true with bottom uniformly sloped to low points. 3"/100' run to drain valve. Pipe should be snaked in trenches to allow for expansion and contraction. Chalk areas to be trenched for approval before excavation.

B. Trench Depth: Excavate trenches to a depth of invert of pipe.

1. PVC Mainline Piping: 24" to top of pipe, 36" max.
2. Lateral Piping: 18" to top of pipe (rotors)
3. Lateral Piping: 18" to top (sprays)

C. Installation of Piping Under Paving: Contractor is to match and install new paving and base with existing paving and base where cutting of paving is necessary for installation of piping.

Any cracking or breaking of the walk is to be repaired at Contractor's expense.

D. Backfill: Backfill with clean material from excavation. Remove organic material as well as rocks and debris larger than 1" diameter. Place acceptable backfill material in 6" lifts, compacting each lift. Puddle each trench thoroughly and assure that no sinking occurs.

3.03 INSTALLATION

A. General: Comply with requirements of the Uniform Plumbing Code.

B. Connection to Main: Connect to location indicated. See irrigation plans.

C. Section Valves: Install a valve box, arranged for easy adjustment and removal. Highline Access Boxes; see irrigation plans. Brand cover in 1" min. letters 'SV' for section valve and the appropriate station number to controller.

Adjust automatic control valves to provide flow at rated operating pressure required for sprinkler circuits.

Provide a PVC ball valve upstream of the valve, as shown on the details.

Provide 3” min clearance from the lowest part of the valve assembly to the top of drainage rock inside the box.

Provide 3” min clearance from the tallest part of the valve assembly (top of solenoid) to the underside of the box lid.

Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler zone.

Install one valve per box, arranged for easy adjustment and removal. Allow minimum 24" between valves. Adjust valves to provide flow rate of rated operating pressure required for each lateral.

Valve Boxes and Covers: Install one box and cover for each valve installed. Install box tops 1" above finished grade. Arrange adjacent valve boxes parallel to each other and the same distance apart in a neat and orderly fashion. Install boxes perpendicular to and on a line with adjacent pavement or walls.

D. Sleeving:
1. Main and Lateral Line Sleeving:
    a. Install under paved surfaces as indicated on the drawings.
    b. Minimum depth to top of pipe shall be determined by depth of mainline and lateral lines.
    c. Lay sleeve to drain at minimum grade of 3"/100'.
    d. Ends of Sleeves: Mark in manner to ensure easy location in future. Do not allow sleeves to become filled with soil or other undesirable material.

E. Piping: Lay pipe on solid sub-base, uniformly sloped without humps or depressions.
1. For Mainline Piping: Slope to drain at least 1/2" in 10' run.
2. Install PVC Pipe: Install in dry weather when temperature is above 40 degrees F. (4 deg. C.) in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperature above 40 deg. F. (4 deg. C.) before testing, unless otherwise recommended by manufacturer. Open trenches until testing has been performed. No pipe joints shall be located within sleeve pipes.
3. Install poured concrete thrust blocks according to pipe manufacturer's requirements for all mainline pipe larger than 2 1/2".
4. Install Poly Pipe: Install in dry weather when temperature is above 40 degrees F (4 degrees C) in strict accordance with manufacturer's instructions. Open trenches until testing has been performed.

F. Dielectric Protection: Use dielectric fittings at connection where pipes of dissimilar metals are joined. Use dissimilar metals only with architect's approval.

G. Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed.

Install lawn heads at manufacturer's recommended heights.

Locate part-circle heads to maintain a minimum distance of 6" from walks, 12" away from walls. Allow no backwash or over spray onto walls or fences.

H. Control Wiring: Bury control wiring between controller and electric valves in sprinkler main line trenches.

Make electrical connection at valve to allow for pigtail so solenoid can be removed from valve with sufficient slack to allow ends to be pulled 12" above ground for examination and cleaning.

Bundle 24 volt wires at 15' to 20' intervals and lay with mainline pipe below and to one side only of the trench. (Inside of loop on looped main).

Provide an expansion loop at every valve and every 100' formed by wrapping wire for at least twelve inches, a minimum of sixteen coils around a 0.75" pipe leaving pipe in place. Add length of 3/4" metal pipe between coil and valve, per detail.

Make splices and connections in accordance with NEC. Locate splices and connections at valve boxes, using a 3M DBY kit. Buried splices prohibited. Run four spare #14-1 wires, red color and one #14-1 wires, yellow color, from controller along full length of main (pressure) lines.

Install as per manufacturer's instructions or detail. Connect remote control valves to controller in numerical sequence as shown on the irrigation drawings.

High voltage electrical work shall be performed by a licensed electrician per code. The Contractor shall be responsible for the electrical connection of the controller with the metered electrical line at the base of the controller.

3.04 TESTING

A. General: Notify Landscape Architect in writing not less than 16 working hours in advance of when testing will be conducted. Conduct tests in the presence of the Landscape Architect.

Before sprinkler heads are set, thoroughly flush the lines to remove all foreign matter.

Flush from dead end fittings for a minimum of five minutes under a full head of pressure.

B. Hydrostatic Test: Test main piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 100 psi for a period of 4 hours. If the pressure loss is greater than 2 PSI over the testing period, repairs shall be made and the system re-tested until it passes. Piping may be tested in sections to expedite work. Provide photos of pressure gauge at beginning and end of pressure test and provide written documentation of test results to the Owner.

C. Operational Testing: Perform operational testing after hydrostatic testing is completed, backfill is in place, and sprinkler heads adjusted to final position.
   1. Demonstrate to Landscape Architect that system meets coverage requirements and that automatic controls function properly.
   2. Coverage requirements are based on operation of one circuit at a time.
      After completion of grading, seeding or sodding, and rolling of grass areas, carefully adjust lawn sprinkler heads so they will be flush with finish grade.

      Flush and adjust sprinkler heads for optimum performance and to prevent overspray onto walks, roadways, and buildings.

      If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, make such adjustments prior to final acceptance at direction of Landscape Architect. Adjustments may also include changes in nozzle sizes and degrees of arc as required.

Correct areas which do not conform to designated operation requirements due to unauthorized changes or poor installation practices.

3.05 FINAL PROCEDURES AND INSPECTIONS

A. Walk-Through for Substantial Completion:
   1. Arrange for Landscape Architect's presence 48 hours in advance of walk-through.
   2. Entire system shall be completely installed and fully operational prior to scheduling of walk-through. This shall include all control valves capable of being operated via irrigation controller.
   3. Electrically operate each zone in its entirety for Landscape Architect and open all valve boxes if directed.
   4. Landscape Architect will generate a list of items to be corrected prior to Final Acceptance.
   5. Furnish all extra materials and perform all work required to correct all inadequacies of coverage due to deviations from Contract Documents.
   6. During walk-through, expose all drip emitters under operation for observation by Landscape Architect to demonstrate that they are performing and installed as designed, prior to placing of all mulch material. Schedule separate walk-through if necessary.
   7. Supply Landscape Architect with one set of full-size prints (not original drawings) of completed contractor-prepared irrigation as-built field drawings prior to start of substantial completion walk-through.

END OF SECTION

SECTION 32 91 13
FINE GRADING AND SOIL PREPARATION

PART 1 GENERAL

1.01 WORK INCLUDED

A. Ripping.

B. Fertilizer.

C. Soil amendments.

D. Fine grading.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Section 31 00 00: Earthwork.

B. Section 32 84 00: Irrigation.

C. Section 32 90 00: Planting.

D. Section 32 91 19: Landscape Maintenance.

E. Section 32 92 19: Seeding.

F. Section 32 92 23: Sodding.

G. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 SUBMITTALS

A. Quality Control Submittals:
   1. Certificates: State, federal and other inspection certificates shall accompany invoice for all materials showing source or origin. Submit to Owner's Representative prior to acceptance of materials.
   2. Soil Amendment Test Report: Submit soil conditioner test analysis to Owner's Representative 3 weeks prior to delivery to site in accordance with Section 01 3300.
   3. Topsoil: Submit soil analysis report for proposed topsoil in accordance with “Method of Soil Analysis- - Agronomy #9” as published by the American Society of Agronomy.

1.04 QUALITY ASSURANCE

A. The work of this section shall be performed by an experienced landscape installer having not less than 5 years successful experience and a minimum of 5 landscape projects of similar size and scope as this project. Include work of Sections 32 9000, 32 9219 and 32 9223 for undivided responsibility.

1.05 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Section 01 6600.

B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened containers bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, bearing name and warranty of producer.

C. Notify Landscape Architect of delivery schedule in advance so material can be inspected upon arrival at project site. Immediately remove unacceptable material from project site.

1.06 PROJECT/SITE CONDITION

A. General: Do not perform work when climate and existing site conditions will not provide satisfactory results.

B. Vehicular accessibility on site shall be as directed by owner's representative. Repair damage to prepared ground and surfaces caused by vehicular movement during work under this section to original condition at no additional cost to Owner.

C. Perform soil preparation just prior to planting operations and in accordance with final planting schedule. Coordinate with irrigation system installation to avoid damage to work of one by the other.

D. Utilities: Determine location of underground utilities and perform work in a manner which will avoid damage. Hand excavate, as required.

PART 2 PRODUCTS

No substitutions will be accepted for material suppliers.

2.01 SOIL AMENDMENTS

A. Composted Amendment: BioComp compost by A-1 Organics (class I compost) or approved equal.
   1. Finely shredded, free of plants, roots, sticks, stones, lumps and noxious weeds. The material shall have acidity within the pH range of 6.0 to 8.4, and a salt content not more than 2.5 mmhos/cm and meet the Class I requirements. The Contractor shall submit a sample and test results from an approved soils testing laboratory showing the acceptable mixture composition and analysis for approval (10) days before delivery to the site. Analysis shall be within 6 months of the current date. Sand, gypsum and mountain peat moss are not acceptable.
   2. Sodded or Seeded Lawns: Apply at a rate of 4 cubic yards per 1,000 s.f.

B. Compost Certification Specifications:
   1. Composted soil amendments must be produced at a facility permitted and regulated under the State of Colorado Department of Public Health and Environment and/or the county in which the facility operates for the production of compost and soil amendments.
   2. The product must be certified to have been produced in a manner that meets the US EPA 40CFR 503.13 minimum standards for pathogen destruction under a controlled, monitored, and documented process.
   3. The supplier must certify that no supplemental nitrogen or other chemicals have been added to the compost to alter or enhance the results of the laboratory analysis, unless specifically requested by the design architect.
   4. The contractor must supply a letter of certification from the manufacturer which confirms that the product being supplied has met the referenced requirements and that supporting documentation exists and is available for inspection (if requested).

2.02 TOPDRESSING

A. Amended topsoil by A-1 Organics, or equal, will be used to topdress sod areas to be overseeded.

2.03 TOPSOIL

A. Clean topsoil will be stockpiled or imported for seeded and sodded areas and spread to 6" minimum depth under other Sections of this Division.

B. All imported topsoil shall be a loam or sandy loam. At least 10 days prior to topsoil delivery, notify Owner's Representative of the source(s) from which topsoil is to be furnished. Topsoil shall be furnished by the contactor and shall be a natural, friable soil representative of productive soils in the vicinity. It shall be obtained from the top 12" of well drained areas, and shall be free of admixture of subsoil, large clods, foreign matter, objects larger than one inch in any dimension, toxic substances, and any material or substances that may be harmful to plant growth. For all topsoil, the pH value shall fall between a range of 6.0 to 7.5, and it shall have a minimum organic matter content of 2.9%.

C. Submit soil analysis report for proposed topsoil in accordance with "Method of Soil Analysis – Agronomy #9" as published by the American Society of Agronomy.

D. Before delivery of topsoil, furnish Landscape Architect a soil analysis made by an acceptable soil testing laboratory stating percentages of silt, clay, sand and organic matter, pH and mineral and plant nutrient content of topsoil for both plant and lawn growth. If not suitable, state recommended quantities for nitrogen, phosphorus, potash and trace elements; and any limestone, aluminum sulphate or other soil amendments to be added to make topsoil suitable for trees/shrubs, for lawn and for planters.

E. Provide topsoil for the entire sodded field area to a minimum depth of 4". Contractor to provide written verification of topsoil quantity at the time of delivery. Owner's Representative to be notified after stockpiling to inspect quantity and quality of topsoil. Contractor to protect topsoil through all construction. If quantity stockpiled is insufficient, contractor is to import remainder of topsoil at his own expense.

F. At the completion of other work in each area to be sodded, place and grade topsoil to Landscape Architect's satisfaction. Scarify top 4" of backfill prior to placing topsoil.

2.04 FERTILIZER

A. Commercial Fertilizer:
   1. Native Seeded Areas: Commercial fertilizer having an analysis of 5% available nitrogen (sulfur-coated Urea only) and 40% available phosphorus (5-40-0). Provide in sufficient quantity to apply at the rate of 5 lbs. nitrogen per acre.
   2. Sodded Lawns:
      a. Commercial fertilizer having an analysis of 46% available nitrogen (Urea and sulphur-coated Urea only) (46-0-0) in sufficient quantity to apply at a rate of 50 lbs. nitrogen per acre.
      b. Treble phosphate (0-46-0) in sufficient quantity to apply at a rate of 650 lbs. per acre.
   3. Seeded Lawns:
      a. Commercial fertilizer having an analysis of 18% available nitrogen (sulphur-coated Urea only) and 46% available phosphorous (18-46-0). Provide in sufficient quantity to apply at the rate of 50 lbs. nitrogen per acre.

2.05 HERBICIDE

A. Roundup by Monsanto: Apply according to manufacturer's instructions using certified applicators.

PART 3 EXECUTION

3.01 EXAMINATION

A. General: Verify that existing site conditions are as specified and indicated before beginning work under this section.
   1. Grades: Inspect to verify rough grading is within + 0.1 foot of grades indicated and specified.
   2. Damaged Earth: Inspect to verify that earth rendered unfit to receive planting due to concrete water, mortar, limewater or any other contaminant dumped on it has been removed and replaced with clean earth from a source approved by the Owner's Representative.

B. Unsatisfactory Conditions: Report in writing to General Contractor with copy to Landscape Architect and Owner.

C. Acceptance: Beginning of installation means acceptance of existing conditions by installer.

3.02 PREPARATION

A. Protection:
   1. Locate sewer, water, irrigation, gas, electric, phone and other pipelines or conduits and equipment prior to commencing work.
   2. Be responsible for proper repair to landscape, utilities, walls, pavements and other site improvements damaged by operations under this section.
   3. Pay for repairs made by contractor(s) designated by Owner.

B. Weed Control: Remove perennial weeds by applying herbicide 1 week before final grading and as needed. Remove annual weeds by tilling. Water prepared soil for two weeks if possible and apply herbicide to exposed weeds.

C. Surface Grade: Remove weeds, debris and rocks larger than 1/2". Dispose of accumulated debris at direction of Landscape Architect and owner.

D. Runoff: Take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water to run off the grounds as is intended by the grades.

E. Erosion Control: Take measures and furnish equipment and labor necessary to control and prevent soil erosion, blowing soil and accumulation of wind-deposited material on the site throughout duration of work.

3.03 INSTALLATION

A. Soil Amendment
   1. Limit preparation to areas which will be planted promptly after preparation.
   2. Before tilling, clean topsoil of stones, clay lumps, and other extraneous materials harmful or toxic to plant growth. Leave seeds and plants for native seed areas. Use soil devoid of seeds and plants in sodded and seeded lawn areas.
   3. Sodded Lawns: Spread soil amendments and phosphate at the rate specified after topsoil (if specified) is spread. Till in thoroughly to a minimum depth of 6"-9", and grade to meet lines, grades and elevations shown, allowing for natural settlement.
   4. Native Seed: Spread soil amendments and fertilizer at the rate specified after topsoil (if specified) is spread. Till in thoroughly to a minimum depth of 6", and grade to meet lines, grades and elevations shown, allowing for natural settlement.
   5. ***Overseeded Lawns: Aerate, overseed, and topdress with ½" of amended topsoil, then seed with 4-8lbs/1000sf of bluegrass blend.***

B. Fine Grading in all Landscape Areas:
   1. Do fine grading for areas immediately prior to planting.
   2. For ground surface areas surrounding buildings to be landscaped, maintain required positive drainage away from buildings.
   3. Establish finish grades to within 0.05 foot of grades indicated. The intent of this spec is to prevent 'bird baths' or ponding.
   4. Finish grade to be below edge of pavement prior to sodding, seeding or planting.
      a. Sodded Areas: Allow 1.5" for sod.
      b. Shrub Beds: Allow 4" for crusher fines and 6" for cobble.
      c. Seeded Areas: Allow 1" for seed.
   5. Noxious weeds or parts thereof shall not be present in the surface grade prior to landscaping.
   6. Compaction of Surface Grade Prior to Landscape Installation: Firm, but not hard (80% standard Proctor density within 2% optimum moisture).
   7. Prior to acceptance of grades, rake to smooth, even surface free of debris, clods, rocks, and vegetable matter greater than 1". Native seed areas should not be raked smooth but left in a uniform condition after tilling. Rough raking may occur parallel to the contour only.
   8. Sodded Lawns: Apply nitrogen fertilizer, at the rate specified, after fine grading and prior to sodding.
   9. Restore planting areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.04 NOTIFICATION AND INSPECTION

A. Inspection: Provide notice to Landscape Architect requesting inspection at least 7 days prior to anticipated date of completion.

B. Deficiencies: Landscape Architect will specify deficiencies to Contractor who shall make satisfactory adjustments and shall again notify Owner's Representative for final inspection.

3.05 CLEANING

A. General: Remove debris and excess materials from site. Clean out drainage inlet structures. Clean paved and finished surfaces soiled as a result of work under this section, in accordance with direction given by Owner's Representative.

3.06 PROTECTION

A. General: Provide and install barriers as required and as directed by Landscape Architect to protect completed areas against damage from pedestrian and vehicular traffic until acceptance by Owner. Contractor is not responsible for malicious destruction caused by others.

3.07 WARRANTY

A. Contractor to warrant for a period of two years that puddling, sinking or caving directly due to earthwork operations does not occur.

END OF SECTION

SECTION 32 92 19
SEEDING

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Seeding and fertilizing.

B. Hydro mulching.

C. Maintaining seeded areas until acceptance.

1.02 REFERENCES

A. Reference Standards: Comply with U.S. Department of Agriculture Rules and Regulations under Federal Seed Act and be equal in quality to standards for Certified Seed.

1.03 SUBMITTALS

A. Quality Control Submittals:

1. Certificates: State, federal or other inspection certificates shall accompany the invoice for materials showing source or origin. Submit to Owner's Representative prior to acceptance of the material.

B. Contract Closeout Submittals:

1. Operating and Maintenance Data: At completion of work, submit 3. Include directions for irrigation, aeration, mowing, fertilizing and spraying as required for continuance and proper maintenance through full growing season and dormant period.

2. Contractor to provide all delivery load tickets for seed, fertilizer, and mulch prior to acceptance of work under this section.

3. Warranty for Seed Areas: At completion of work, furnish written warranty to Owner based upon requirements as specified. See Section 3.08.

1.04 QUALITY ASSURANCE

A. Planting and seeding shall be done with the approval of the Owner's Representative only when the ground is not frozen, snow covered, or in an otherwise unsuitable condition for planting. Special conditions may exist that warrant a variance in the specified planting dates or conditions. A written request shall be submitted to or originate from the Owner's Representative stating the special conditions and proposed variance.

B. Seeding shall be done within the following dates:
1. Native/dryland seed - From March 1 to May 1 for spring seeding; and from October 1 to November 15 for fall seeding.

2. Turfgrass seed – From March 1 to May 1 for spring seeding, and from August 15 to September 15 for fall seeding.

1.05 DELIVERY, STORAGE AND HANDLING

A. Seed: Deliver seed in sealed standard containers stating correct name and composition on the outside of the container. Seed damaged in transit or storage will not be accepted. Retain tickets for submittal to Owner’s Representative.

B. Fertilizer: Deliver inorganic or chemical fertilizer to site in original unopened container bearing manufacturer's guaranteed chemical analysis, name, trade name, trademark and conformance to state law, and bearing name and warranty of producer. Retain tickets for submittal to Owner’s Representative.

C. Material may be inspected upon arrival at project site.

D. Immediately remove the unacceptable material from job site.

1.06 EXISTING CONDITIONS

A. Beginning work means acceptance of existing conditions.

PART 2 - PRODUCTS

2.01 GROWING MEDIA

A. Fertilizer: Specified in Section 329100.

2.02 SEED

A. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, the lot number, net weight, the percent of weed seed content, and the guaranteed percentage of purity and germination. All brands furnished shall be free from such noxious seeds such as Russian or Canadian Thistle, European Bindweed, Johnson Grass, and Leafy Spurge. The Contractor shall furnish to the Owner's Representative a signed statement certifying that the seed furnished is from a lot that has been tested within six months prior to the date of delivery. Seed which has become wet, moldy, or otherwise damaged in transit or in storage will not be acceptable. Seed shall be certified to be a hardy strain of the following seeds at the indicated rates of pure live seed per acre.

B. Computations for quantity of seed required are based on the percent of purity and percent of germination: Pounds of seed x purity x germination = pounds of pure live seed (PLS).

C. Seed and seed labels shall conform to all current State and Federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.

D. Provide the following seed mixtures and rates:

1. Native grass seed mix – Foothills Mix by Arkansas Valley Seed, or approved equal, by weight percentage for each species.

Common Name	%
Annual Ryegrass	(20%)
Slender Wheatgrass	(15%)
Crested Wheatgrass	(12%)
Mountain Brome	(10%)
Hard Fescue	(10%)
Canada Bluegrass	(10%)
Sideoats Grama	(6%)
Big Bluestem	(6%)
Blue Grama (Coated)	(5%)
Switchgrass	(5%)
Sand Dropseed	(1%)

2. Turf grass seed mix – Pro-Sports Turf Mix – Sown over athletic fields. Distributed by Arkansas Valley Seeds, or equal.

- ***a. Odyssey Kentucky Bluegrass (Midnight Type) 25%***
- ***b. SR2100 Kentucky Bluegrass (Shamrock Type) 25%***
- ***c. SR4600 Perennial Ryegrass 25%***
- ***d. Manhattan 4 Perennial Ryegrass 25%***
- ***e. Overseed at 4 lbs/1,000sf.***

2.03 ACCESSORIES

A. Mulching Material: Bonded fiber matrix free of growth or germination inhibiting ingredients.

B. Mulch Binder: Flexterra, or equal.

C. Netting: Soil Saver jute netting.

D. Staples: No 11-gauge steel wire formed into a "U" shape 6" long.

PART 3 - EXECUTION

3.01 PREPARATION OF FINAL GRADE

A. Protect existing underground improvements from damage.

B. Prepare soil as specified in Section 329100.

C. Moisten prepared seed areas in irrigated areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting seed. Do not create a muddy soil condition.

D. Restore seed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.02 FERTILIZING

A. Apply fertilizer as specified in Section 329100.

B. Do not apply grass seed or fertilizer in same machine at same time.

3.03 SEEDING

A. Hydro seeding: Seed to be accomplished using an approved hydro seeder. Do not apply seed and mulch in same machine at same time.

B. Do not sow immediately following rain, or when ground is too dry, or during windy periods.

C. Apply water with fine spray immediately after each area has been sown.

D. Broadcast Seeding:
   1. Small areas inaccessible to seed drilling equipment to be seeded by broadcast method using a drop or whirly-bird type spreader. Seed shall be broadcast at double the application rates specified above. Apply seed in two equal applications, in perpendicular directions, to assure uniformity.
   2. Lightly rake seeded areas after seed is broadcast. Final raking shall be in a direction perpendicular to the slope of the land.
   3. Seeding will not be permitted when wind velocity is such as to prevent uniform seed distribution. No application shall be undertaken during inclement or the forecast of inclement weather. No application shall take place in the presence of free surface water or when the ground is frozen or otherwise untillable.

3.04 MULCHING

A. Mulch Application: Mulching of seed areas to be accomplished using an approved hydro mulcher to apply Bonded Fiber Matrix at rate of 3,000 pounds per acre.

B. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow, or other causes.

C. Areas not properly mulched, or damaged due to the Contractor's negligence, shall be repaired and mulched in an acceptable manner at the Contractor's expense. Mulch removed by wind prior to acceptance shall be re-established by the contractor at his own expense.

D. The seeded area shall be mulched within 24 hours after seeding. Areas not mulched within 24 hours after seeding must be re-seeded with the specified seed mix at the Contractor's expense.

E. Contractor is to remove all hydro mulch from plant materials, fences, paved areas, and buildings as directed by owner.

3.05 EROSION CONTROL

A. Area: Apply jute netting and/or mulch binder to any area which is vulnerable to soil erosion such as swales or steep slopes (over 3:1).
   1. If Contractor fails to control such areas and soil erosion subsequently occurs, Contractor shall re-establish finish grade, soil preparation, seed bed, and apply erosion control at his own expense.

B. Jute Netting:
   1. Roll out in direction of flow after seeding and mulching.
      a. Apply material loosely and smoothly on soil surface without stretching.
      b. Avoid walking directly on seedbed either before or after jute is applied.
      c. Bury up-channel end of each piece of jute netting in narrow trench 6" deep. After jute is buried, tamp trench firmly closed.
   2. In cases where one roll of netting ends and second roll is needed, overlap up-channel piece over second roll by at least 18". Where two or more widths of netting are applied side by side, make overlap of at least 4".
   3. Outside Edges of Netting: Spread loose topsoil over edges to allow for smooth entry of water.

C. Stapling: Staple overlaps which run parallel to direction of flow in channel bottoms on 2 ft. intervals. Staple outside edges, centers and overlaps on banks on 2 ft. intervals.
   1. Each Width of Cloth: Install row of staples down center as well as along each side.
   2. Staple check slots and junctions of new rolls across channel on 6" intervals.
   3. On soft or sandy soil or in windy areas. apply staples in alternative slanting position and space at 14" to 18" intervals.
   4. For extra hard soil or shale areas, use sharp hardened steel 3" fence type staples. Do not use 3" staples on normal turf.

3.06 CLEAN UP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition. Any damage to other work done by landscape crew is to be reported and repaired immediately.

B. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.07 ACCEPTANCE

A. Seeded areas will be accepted upon the establishment of an even, uniform grass cover. This does not imply that a full sod is necessary. The result is based on a visual evaluation indicating a uniform ground cover of about 90% germination with no bare spots larger than 6" diameter. Contractor to maintain seeded areas until acceptance, and through maintenance period.

3.08 WARRANTY

A. Warranty for Native and Dryland Seeded Areas: Warrant areas in seed to be in a healthy, vigorous growing condition, and for consistency and completion of coverage at the end of a period of two years from date of acceptance. During the warranty period, re-seed any spots where seed has not germinated within the total seeding area. Continue this procedure until a successful stand of grass is growing and accepted by the Owner's Representative. Warranty period will be extended if necessary, until a uniform 90% germination rate has been accomplished.

END OF SECTION

SECTION 32 92 23
SODDING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Placing Sod

1.02 RELATED WORK

A. Section 32 84 00: Irrigation.

B. Section 32 90 00: Planting.

C. Section 32 91 13: Fine Grading and Soil Preparation.

D. Section 32 91 19: Landscape Maintenance.

1.03 REFERENCES

A. ASPA (American Sod Producers Association) - Guideline Specifications to Sodding.

1.04 SUBMITTALS

A. Quality Control Submittals:
   1. Certificates: State, federal and other inspection certificates shall accompany the invoice for materials showing source of origin. Submit to Owner's Representative prior to acceptance of material.
   2. Submit mix specification showing variety and percentage in the mix for approval two weeks prior to installation.

B. Contract Closeout Submittals:
   1. Operating and Maintenance Data: At completion of work, submit 3 copies of data. Include directions for irrigation, fertilizing, aeration, mowing, and spraying as required for continuance and proper maintenance through a full growing season and dormant period.

1.05 QUALITY ASSURANCE

A. The work of this section shall be performed by an experienced landscape installer having not less than 5 years successful experience and a minimum of 5 landscape projects of similar size and scope as this project. Include work of sections 32 9000, 32 9213 and 32 9219 for undivided responsibility.

B. Coordination: Plant trees and shrubs after final grades are established and prior to planting of lawns, unless otherwise acceptable to Owner's Representative. If planting of trees and shrubs occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.06 DELIVERY, STORAGE AND HANDLING

A. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.

PART 2 PRODUCTS

2.01 MATERIALS

A. Sod: Provide strongly rooted sod, not less than two years old, free of weeds and undesirable native grasses and machine cut to pad thickness of 3/4" (+ 1/4"), excluding top growth and thatch. Provide only sod capable of vigorous growth and development when planted (viable, not dormant).
   1. Provide sod of uniform pad sizes with maximum 5% deviation in either length or width. Broken pads or pads with uneven ends will not be acceptable. Sod pads incapable of supporting their own weight when suspended vertically with a firm grasp on upper 10% of pad will be rejected. Provide large roll sod at all athletic and play fields. Rolls to be minimum of 42” wide with no intermediate seams.
   2. Bluegrass Sod: Provide locally grown sod composed of the following: Four varieties of bluegrass including one Elite drought tolerant, one Elite shade tolerant, one aggressive and one dense.

B. Water: Clean, fresh and free of substance or matter which would inhibit vigorous growth of grass.

PART 3 EXECUTION

3.01 PREPARATION OF FINAL GRADE

A. Restore lawn areas to condition specified in Section 32 9113 if eroded or otherwise disturbed after fine grading and prior to planting.

3.02 FERTILIZING

A. Apply commercial nitrogen fertilizer as specified in Section 32 9113. Apply after fine grading and prior to compaction.

B. Lightly water to aid the breakdown of fertilizer.

C. Apply fertilizer within 48 hours before laying sod.

D. Apply second fertilization at one half rate three weeks after sodding is completed.

3.03 LAYING SOD

A. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.

B. Remove all netting from sod rolls.

C. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Tamp or roll lightly to insure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.

D. Water sod thoroughly with a fine spray immediately after planting.

E. Rolling: When soil and sod are moist, roll sod lightly as soon as possible after it is laid. Delay rolling until just before the second watering.

F. Topsoil: Add along exposed edges to match adjacent grade. Feather topsoil out approximately 1 ft. from edge of sod.

G. Drainage: Assure finished areas of sod are such that positive drainage of storm and irrigation water will occur and ponding of water will be minimized.

3.04 REPAIR OF EXISTING SOD AREAS DISTURBED BY RENOVATION

A. Repair existing sod areas disturbed by renovation work (utilities, paving, etc.) as indicated, in accordance with specifications of this section.

3.05 ACCEPTANCE

A. Sod will be inspected at time of final walk through. Sod must be mowed within three days prior to this inspection.

B. Sod will be inspected for health, vigor, and quality of installation:

C. All seams between sod pieces to be tight.

D. Surface grade is to be smooth, without pits, humps, or pock marks.

E. Sod must be free of weeds and undesirable grasses.

F. Sod will not be accepted until after date of Final Acceptance and a minimum of two mowings have been completed.

3.06 WARRANTY

A. Sod: Warrant sod for a period of one year from date of Final Acceptance. Sod to be in a healthy, vigorous growing condition.
   1. During the original warranty period, replace at once sod areas that die due to natural causes, etc. or which in Landscape Architects opinion are unhealthy.
   2. Replacement will not be required in any season definitely unfavorable for sodding.
   3. Install replacements as originally specified and warranted.

4. Overseeding: During the warranty period, re-seed any spots where seed has not germinated within the total seeding area. Continue this procedure until a successful stand of grass is growing and accepted by the Owner's Representative. Warranty period will be extended if necessary, until a uniform 75% germination rate has been accomplished.

END OF SECTION

SECTION 32 93 00
PLANTING

PART 1 GENERAL

1.01 WORK INCLUDED

A. Trees and shrubs.

B. Temporary support.

C. Mulch.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Section 32 92 23: Sodding

B. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 QUALITY ASSURANCE

A. The work of this section shall be performed by an experienced landscape installer having not less than 5 years successful experience and a minimum of 5 landscape projects of similar size and scope as this project. Include work of sections 32 90 00, 32 92 13 and 32 92 19 for undivided responsibility.

B. Perform work with personnel experienced in the work required of this Section under direction of a skilled foreman.

C. All plantings are to be installed per the ALCC Standards and Specifications details book.

D. Staking: All final lines and grades to conform to grade stakes set and approved prior to work.

E. Source Quality Control:
   1. General: Ship landscape materials with certificates of inspection required by governing authorities. Comply with regulations applicable to landscape materials.
   2. Do not make substitutions. If specified landscape material is not obtainable, submit proof of non-availability to Owner's Representative, together with proposal for use of equivalent material.
   3. Procurement: The entering of a proposal and execution of a contract will be construed as evidence that the Contractor has made successful procurement arrangements for all plant materials as specified.
   4. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.
   5. Trees, Shrubs, and Plants: Provide trees, shrubs and plants of quantity, size, genus, species and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard of Nursery Stock." Provide healthy, vigorous stock, grown in a recognized nursery in accordance with good horticultural practice and free of disease, insects, eggs, larvae, and defects such as knots, sunscald, injuries, abrasions, or disfigurement.
   6. Hardiness: Plants grown in hardiness zones 1, 2, 3, and 4 only will be accepted. Hardiness zones are defined in U.S. Dept. of Agriculture publications. Grower's certificates may be required when doubt exists as to the origin of plant material.
   7. Plant Source: All plants shall be nursery grown or gathered native plants approved by Owner's Representative. Imported plants shall have been growing in a nursery for a minimum of one growing season. Trees and shrubs shall have been root-pruned during their growing period in the nursery in accordance with standard nursery practice.
   8. Label each tree and shrub with securely attached waterproof tag bearing legible designation of botanical and common name.

a. Where formal arrangements or consecutive order of trees or shrubs are shown, select stock for uniform height and spread, and label with number to assist symmetry in planting.

9. Inspection: The Owner's Representative may inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for genus, species, variety, size, and quality. Owner's Representative retains right to further inspect trees and shrubs for size and condition of balls and root systems, insects, injuries, and latent defects, and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from project site.

1.04 SUBMITTALS

A. Certification: Submit certificates of inspection as required by governmental authorities. Submit manufacturer's or vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

B. Planting Schedule: Verbally submit proposed planting schedule, indicating dates for each type of landscape work during normal seasons for such work in area of site. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

C. Samples: Submit wood mulch sample to Landscape Architect 3 weeks prior to delivery.

1.05 DELIVERY, STORAGE AND HANDLING

A. Packaged Materials: Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery, and while stored at site.

B. Move plant materials with solid balls wrapped in burlap, or in approved containers.

C. Deliver plant materials immediately prior to placement. Keep plant materials moist.

D. Planting: All plantings to be installed per the ALCC Standards and Specifications details book.

E. Reject plants when ball of earth surrounding roots has been cracked or broken prior to or during process of planting.

F. Reject plants when burlap, stakes, and ropes required in connection with transplanting have been displaced prior to acceptance.

1.06 JOB CONDITIONS

A. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.

C. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Owner's representative before planting.

D. Planting Time: Plant or install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of final completion.

1.07 WARRANTY

A. Provide one-year warranty from date of Final Acceptance.

B. Replace plant materials found dead, or not in a healthy growing condition. Vandalism or negligent acts by maintainer after acceptance will not be grounds for replacement at Contractor’s expense.

C. Replacements: Plant materials of same size and species, with a new warranty commencing on date of replacement.

D. Remove and replace trees, shrubs, or other plants found to be dead or in unhealthy condition during warranty period. Make replacements during growth season following end of warranty period. Replace

trees and shrubs which are in doubtful condition at end of warranty period, unless, in the opinion of the Landscape Architect, it is advisable to extend the warranty period for a full growing season.

1. Another inspection will be conducted at the end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement (per tree, shrub, or plant) will be required at end of warranty period, except for losses or replacements due to failure to comply with specified requirements.

PART 2 PRODUCTS

2.01 MATERIALS

A. Trees and shrubs. Species and size identified in plant schedule, grown in climatic zones 1, 2, 3, or 4.

B. Planting Pit Backfill: Soil backfill for planting pits shall consist of the following mixture:
   1. Two parts native soil from pit excavation.
   2. One part planter mix per Section 32 9113.
   3. Materials to be thoroughly blended.

C. Mulching: All single trees and shrubs shall be mulched with 4” to 6” depth clean cedar mulch. Mulch shall form a circle, 30” radius, from the outer bark layer to the edge of the ring, around single trees utilizing a granular pre-emergent weed control under mulch layer.

2.02 PLANT MATERIALS

A. Quality: Provide trees, shrubs, and other plants of size, genus, species, and variety shown and scheduled for landscape work and complying with recommendations and requirements of ANSI Z60.1 "American Standard of Nursery Stock."

B. Deciduous Trees: Provide trees of height and caliper scheduled or shown and with branching configuration recommended by ANSI Z60.1 for type and species required. Provide single-stem trees, except where special forms are shown or listed.
   1. Provide balled and burlapped (B&B) deciduous trees.
   2. Container grown deciduous trees will be acceptable in lieu of balled and burlapped deciduous trees subject to specified limitations of ANSI Z60.1 for container stock.
   3. Field dug deciduous trees will be accepted based on prior approval by Owner's representative.

C. Deciduous Shrubs: Provide shrubs of the container size shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required. All shrubs will be container grown in the sizes indicated on the plans.

D. Coniferous and Broadleaf Evergreens: Provide evergreens of sizes shown or listed. Dimensions indicate minimum height for upright trees, such as globe, dwarf, cone, pyramidal, broad upright, and columnar. Provide normal quality evergreens with well-balanced form complying with requirements for other size relationships to the primary dimension shown.
   1. Provide balled and burlapped (B&B) evergreens.
   2. Container grown evergreens will be acceptable subject to specified limitations for container grown stock.
   3. Field dug evergreen trees will be accepted based on prior approval by Owner's representative.

2.03 ACCESSORIES

A. Wrapping: Tree wrap tape not less than 4" wide, designed to prevent borer damage and winter freezing.

B. Stakes and Guys: Provide wood stakes where indicated on plans. Provide wire ties and guys of 2-strand, twisted, pliable metal form tie wire not lighter than 12 gauge. Provide 1” canvas strap (18" minimum), to protect tree trunks from damage by wires and ½” PVC pipe over wire for wire visibility.

PART 3 EXECUTION

3.01 PREPARATION

A. Layout individual tree and shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Owner's Representative's acceptance before start of planting work. Make minor adjustments that may be requested.

B. Preparation of Soil Backfill for Planting Pits:
   1. Before mixing, clean pit excavations of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful or toxic to plant growth.
   2. Mix specified soil amendments with soil at rates specified.

C. Sequencing and Scheduling:
   1. Planting Time: Proceed with, and complete landscape work as rapidly as portions of site become available, working within seasonal limitations.
      Plant or install materials during normal planting seasons for each type of plant material required.
   2. Correlate planting with specified maintenance periods to provide maintenance from date of final completion.

D. Excavation for Trees and Shrubs:
   1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage.
      Loosen hard subsoil in bottom of excavation.
      a. For bare root trees and shrubs, make excavations at least 24" wider than root spread and deep enough to allow for setting of roots on a layer of compacted backfill and with collar set at same grade level as in nursery, but 2" above finished grade at site. Allow for 9" setting layer of planting soil mixture.
      b. For balled and burlapped (B&B) trees and shrubs, or container grown stock, make excavations at least 24" radius wider than the ball diameter and 2" shallower than ball depth.
      c. For container grown stock, excavate as specified for balled and burlapped stock, and excavate pits to a width at least twice as wide as the containers and at least as deep as the containers.
      d. Dispose of unacceptable subsoil removed from landscaped excavations. Do not mix with planting soil or use as backfill.
      e. Use prepared plant backfill mix for setting and filling all plants.
      f. Where rubble fill is encountered, notify Landscape Architect and prepare planting pits properly by removal of rubble or other acceptable methods. When conditions encountered are severe and extensive (as determined by Architect) proceed with additional work at the direction of the Architect.
      g. Drainage: If subsoil conditions indicate the retention of water in planting areas, as shown by seepage or other evidence indicating presence of underground water, notify the Landscape Architect before backfilling.

E. Fill excavations for trees and shrubs with water and allow to percolate out before planting.

3.02 INSTALLATION

A. Planting Trees and Shrubs:
   1. Set balled and burlapped (B&B) stock on layer of compacted planting soil mixture, plumb, and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades or as noted. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When backfilling is complete water well with root-feeder probe.
   2. For container grown stock, remove plant from container, split root ball 50% up from bottom, spread roots over mounded backfill under roots as required to eliminate voids and prevent settling. Complete backfilling on top of pit.
   3. Mound top of backfill in irrigated areas. Provide bowl for water retention in dryland areas.
   4. Anti-desiccant: If deciduous trees or shrubs are moved in full-leaf, spray with anti-desiccant at nursery before moving.
   5. Remove and replace excessively pruned or mis formed stock resulting from improper pruning.
   6. Wrap tree trunks of 1" caliper and larger. Start at ground and cover trunk to height of first branches and securely attach with flexible tie. Do not use duct tape. Inspect tree trunks for injury, improper

pruning, and insect infestation and take corrective measures before wrapping. Double wrap all maples.

7. Guy and stake trees immediately after planting, as indicated.

B. Mechanical Spade Planting: Larger evergreen trees may be planted by means of mechanical spade equipment with prior approval. Larger plantings being moved from permanent locations to new locations must be transplanted by this method. Use equipment that will dig, carry, and replant with the same unit. Equipment size must be adequate for size of plant and not less than 8" of spade diameter at 15" depth per caliper inch of trunk diameter.

C. Mulch: Provide not less than 4" thickness of mulch in all mulch pit and planting beds, unless rock or other mulch is indicated on the drawings. Work into top of backfill in pits and finish level with adjacent finish grades.

3.03 CLEAN-UP AND PROTECTION

A. During landscape work, keep pavements clean and work area in an orderly condition. Any damage to other work done by landscape crew is to be reported and repaired immediately.

B. Protect landscape work and materials from damage due to landscape operations, operations by other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.04 INSPECTION AND ACCEPTANCE

A. When landscape work is completed, Landscape Architect will, upon request, make an inspection to determine acceptability.

1. Landscape work may be inspected for acceptance in parts agreeable to Landscape Architect, provided work offered for inspection is complete.

B. When inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by the Owner's Representative and found to be acceptable. Remove rejected plants and materials promptly from project site.

END OF SECTION

SECTION 32 93 13
INERT GROUND COVER MATERIALS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Rake, level and compact grade to prepare area for inert ground cover materials.

B. Apply pre-emergent herbicide.

C. Spread geotextile fabric (also referred to as filter fabric).

1.02 RELATED SECTIONS AND DOCUMENTS

A. Section 31 00 00: Earthwork.

B. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 QUALITY ASSURANCE

A. General Contractor to inspect cobble mix prior to dumping materials on site.

B. Coordination: All inert ground cover materials to be placed after final grades are established.

C. Perform work with personnel experienced in the work required under direction of a skilled foreman.

D. Place no mulch until all plants have been planted or structures have been placed.

1.04 SUBMITTALS

A. Submit sample of cobble mulch, and crusher fines in the specified sizes to the Landscape Architect for approval at least 48 hours prior to installation.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Any inert ground cover material shall be delivered to site and stored at location arranged by contractor.

1.06 EXISTING CONDITIONS

A. Contractor shall approve existing conditions prior to beginning all landscape work. Beginning work indicates acceptance of existing conditions.

PART 2 PRODUCTS

2.01 MATERIALS

A. Geotextile Fabric: Made from spunbonded non-woven polyester fibers thermally bonded or mechanically bonded by needling. Fabric shall meet or exceed the following properties:

Property	Units	Method
Grab Strength (min.)	90 lbs.	ASTMD-4632
Grab Elongation (min.)	70 lbs.	ASTMD-4632
Trapezoidal Tear Strength (min.)	40 lbs.	ASTMD-4533
Puncture Strength	50 lbs.	ASTMD-3787
Mullen Burst Strength	140 lbs.	ASTMD-3786

Submit sample and properties for approval prior to installation.

B. Pre-Emergent Herbicide: Surflan or approved equal.

C. Crusher Fines:

1. Stabilized Crushed Stone Surface by Stabilizer Solutions, Inc. Contact G & S Stabilizer Solutions Inc. at 303-961-0092. All crusher fines to be stabilized. Color to be buff.

~~C. Infield Mix; G&S Stabilizer Solutions Gold Pro Infield Mix. Contact G & S Stabilizer Solutions Inc. at 303-961-0092 or stabilizersolutions.com.~~

D. Keyed Cobble Mulch: All areas containing keyed cobble shall be round/oval native stream cobble or various gray-white tones. At lease ninety percent (90%) shall be entire, without fracture or cleavage and shall consist of the following percentages by volume:

85%	6" - 12" river stones
15%	Crusher fines

PART 3 EXECUTION

3.01 PREPARATION

A. Fine grade all areas to receive rock and wood mulch cover. Remove all sticks, stones, or clods over 1" in diameter and grade soil smoothly and evenly.

B. Apply pre-emergent herbicide to areas to receive rock and wood mulch ground cover, following manufacturer's directions.

3.02 INSTALLATION

~~A. Infield Mix:~~

~~1. Deposit Infield Mix. Screen to a depth necessary to produce a uniform 6" thick mat after compaction.~~

~~2. Appy in two layers, compacting each. Compact to 95% of standard density at optimum moisture content. Add moisture as necessary. Finished surface shall be 1" above othe surrounding sod, smooth, even and free of lumps and depressions, and drain freely onto grass.~~

B. Compacted Crusher Fines Mulch:
   1. Do not tear or move geotextile fabric. Use extreme care.
   2. At completion of surfacing, remove excess spoils from along material.
   3. Rake along all material edges to ensure finished appearance and positive drainage away from building.

C. Keyed Cobble: Excavate area to be filled with rock to depth per details. Hand place rock on compacted soil from largest to smallest stone. Key any voids with crusher fines. A 10' x 10' section of installed keyed cobble to be approved by landscape architect prior to further installation.

3.03 MAINTENANCE

A. Contractor is responsible to see that inert ground cover materials stay intact and solid until final completion.

B. During maintenance period, Contractor is responsible for repairing or replacing any areas where rock slumps or ground fabric shows through. Contractor will also be responsible for controlling weed growth in mulch areas.

END OF SECTION

SECTION 32 93 50
LANDSCAPE MAINTENANCE

PART 1 - GENERAL

1.01 WORK INCLUDED

A. Section includes maintaining the following items through final acceptance:

1. Irrigation system.
2. Sodded areas.
3. Seeded areas.
4. Tree and shrubs.

1.02 RELATED SECTIONS AND DOCUMENTS

A. Section 32 84 00: Irrigation.

B. Section 32 92 23: Sodding.

C. Section 32 92 19 Seeding.

D. Section 32 93 00 Planting.

E. Drawings and general provisions of the Construction Contract, and Division-01 Specification sections apply to work of this section.

1.03 SUBMITTALS

A. Notices - Submit the following written notices to the Owner:
1. A minimum of one (1) week prior to the start-up or winterization of the irrigation system.
2. A minimum of one (1) week prior to fertilization or the broad application of any chemicals or insecticides of any kind.

1.04 QUALITY ASSURANCE

A. Applicable Codes and Standards
1. Abide by the codes, specifications, and standards of all governmental and industry regulations including but not limited City, County, State of Colorado, and the standards of the American Association of Nurserymen (ANN), American Society for Testing and Materials (ASTM), National Plumbing Code (NPC), Colorado Technical Plumbing Code, Uniform Building Code (UBC), Sprinkler Irrigation Association (SIA), National Electric Code (NEC), American Sod Producers Association (ASPA), United States Department of Agriculture (USDA), and the Association of American Seed Control Officials (AASCO).
2. All labor shall be United States citizens or have current, valid work permits for work within the United States.
3. At all times when work is being performed, Contractor shall have an individual who has successfully completed the Standard First Aid and Personal Safety Course (intermediate level) offered by the American Red Cross or other training as accepted by the Owner.
4. No chemicals or fertilizers shall be utilized on the work without a state licensed operator in attendance.

B. Equipment:
1. All equipment shall be well maintained and equipped with current safety features including audible reverse warning, trimming guards, etc.

1.05 MAINTENANCE PERIOD

A. Required maintenance for all items shall extend until date of final acceptance of the entire project. This period will last through a minimum of two lawn cuttings for sodded areas.

B. After acceptance of the entire project, the Owner will assume responsibility for maintenance.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.01 IRRIGATION SYSTEM

A. Start-Up:
   1. The Contractor shall be responsible for the start-up of the automatic irrigation system. Unless modified by extreme weather conditions, the system shall be activated not before April 1 and not later than April 30.
   2. To activate system, pressurize and then run each zone a minimum of 15 minutes. Each zone shall be observed for leaks, pressure defects, adequate coverage, and other conditions which shall impact the effective operations of the system. Any leaks or defects shall be corrected immediately.

B. Controller Settings:
   1. Properly program the irrigation controller to insure adequate but not excessive watering throughout the year. Contractor shall review zones once per week while system is active.
   2. Following acceptance of the entire project by Owner, the Owner will assume responsibility for controller settings. Contractor may monitor controller settings during the warranty period, but shall not alter the settings without first notifying the Owner in writing.

C. Testing System:
   1. At a minimum of once each month between May and October, manually operate each and every irrigation zone to insure continued and adequate coverage, pressure, and the absence of leaks. All system leaks or defects shall be corrected immediately.

D. Winterization:
   1. The Contractor shall be responsible for the winterization of the automatic irrigation system. Unless modified by extremely mild weather conditions, the system may be shut-down and winterized by November 25. The requirement shall remain in effect even if the Owner has accepted the project. Owner shall be notified of shut down and be present for shut down activities.
   2. In the week immediately prior to closing of the system, all landscape areas shall receive a minimum of 1.5" of watering (either through natural conditions or through operation of the system).
   3. Winterize the system by closing the main pressure valve opening, all stop and waste valves, removing water from the lines, de-energizing the controller, and all other actions deemed prudent. Remove water from drip lines by opening flushing points and blowing out all water.

3.02 SODDED AREAS

A. Fertilization:
   1. Fertilize all sodded areas four (4) weeks minimum after installation.
   2. Fertilizer shall be a Urea based only mixture with the following chemical composition: 46 percent nitrogen, 0 percent phosphorous, and 0 percent potash. All applications shall be at a rate of 5 lbs. nitrogen per 1000 square feet.
   3. These feedings are specifically in addition to those required by the installation specification.
   4. All fertilizer applications shall occur using a commercial spreader on a calm, dry morning. The sod should be moist. Never fill the spreader over the lawn areas or when "on". Sweep all concrete and asphalt areas that may have been pelleted with fertilizer.
   5. In addition to the lawn fertilization, one (1) application of elemental iron shall be made at a rate of 0.5 lbs. per 1000 square feet.

B. Weeding and Insect Toxins: Contractor is responsible for weed control until acceptance of the entire project. No application of insecticides or antifungal chemicals are specified. Apply these elements as necessary to maintain healthy, weed free sod throughout the year. Apply as per manufacturer's recommendations whenever necessary to protect the sod condition.

1. In no case shall application occur on a school day; in the event of the application of these chemicals applies to more than 33 percent of the sod area, a notice of the time of application shall be posted at each building entrance.
2. Take all precautions when applying weed killers, insecticides or antifungal remedies, including gloves, masks, goggles, etc., and shall not apply on windy or rainy days.
3. This section includes insects, molds, fungus, broadleaf, and viney weeds and specifically includes grasshoppers.
4. Notify Owner a minimum of 48 hours in advance prior to application of chemicals.

C. Cuttings: Cut sod with a reel or rotary type mower. Keep grass an average of 2 ½ inches in height and cut whenever the clippings will measure approximately 0.5 inch of 25 percent of the grass plant. Never cut off more than 33 percent of the plant height. Between May 1 and September 15, cut grass a minimum of once every two weeks.
   1. If mowing creates visible accumulations of clippings, clippings must be removed. Remove all clippings immediately. Cross slope all mowing. All areas around walks, buildings, curbs, walls, rocks, plants, lights, or other structures must be trimmed by hand or mechanical trimmer each time the grass is cut. All cuttings must be done diagonal to the way the sod was laid. Clean cuttings from walks, plazas, drives, etc.

3.03 SEEDED AREAS

A. General: The maintenance period shall begin immediately after each area is seeded and continue until final acceptance of entire project. During this time, the Contractor shall be responsible for watering, mowing, spraying, weeding and all related work as necessary to ensure that seeded areas are in a vigorous growing condition. Provide all supervision, labor, material, and equipment to maintain seeded areas.

B. Materials: Conform to specifications or to be acceptable to by Owner.

C. Watering: Water irrigated areas at regular schedule to be accepted by Owner until stand of grass is established. Water in repeated short time periods. After grass is established, water irrigated grass at a regular schedule to be accepted by Owner. Native and dryland grasses are not required to be watered. Water shall be free of substances harmful to plant growth. Be responsible for furnishing water from underground sprinkler system, quick couplers or other source.

D. Reseeding: Per Section 32 92 19.

E. Fertilization: Per Section 32 91 13.

F. Weed Control: Native Seed/Dryland Grasses: As required, using selective herbicides approved by Owner.

G. Insect and Disease Control: As required, apply insecticide and fungicide approved by Owner.

3.04 TREE AND SHRUB CARE

A. Maintenance crew shall inspect the plant material on a monthly basis. A written report of problems shall occur after each inspection.

B. Immediately remove any dead plant or dead part of the plants. Maintenance crew shall remove all tree suckers and leafing on main stems.

C. Each spring, no later than June 1, trim all winter dieback, undesirable shoots, and correct branching problems.

D. Replace at no cost to the Owner any plant material which dies due to failure to comply with this specification or negligence or insect damage. This guarantee applies to trees which are damaged due to maintenance crew's mowing operations.

E. Remove tree stakes, tree guys, guy wire, and tree wrap prior to completion of one-year warranty period.

3.05 WINTER WATERING

A. Contractor's maintenance crew to water all sod, irrigated seed and plant material areas once each month during December, January, February, and March unless the Owner has accepted the project. This watering shall be at a minimum provide 0.5 inch of water for sod and irrigated seed areas as well as deep-root watering each and every shrub.

B. This watering shall occur from sillcocks of the building or quick couplers and must include the cost of supplying all necessary hoses and fittings. If sillcocks are frozen or cannot be activated Contractor shall utilize a water truck.

END OF SECTION

SECTION 33 10 00
WATER UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Buried pipe, fittings, hydrants, valves, appurtenances, and associated accessories for water distribution and transmission lines

B. Disinfection of potable water piping

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 33 19 – Field Test Reporting

C. Section 01 78 23 – Operation and Maintenance Data

D. Section 31 00 00 – Earthwork

E. Section 33 13 00 – Disinfecting of Water Utility Distribution

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM)
1. A36 – Standard Specification for Carbon Structural Steel
2. A48 – Standard Specification for Gray Iron Castings
3. A53 – Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless
4. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
5. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
6. A242 – Standard Specification for High-Strength Low-Allow Structural Steel
7. A276 – Standard Specification for Stainless Steel Bars and Shapes
8. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
9. A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
10. A536 – Standard Specification for Ductile Iron Castings
11. A674 – Standard Practice for Polyethylene Encasement for Ductile Iron Pipe for Water or Other Liquids
12. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
13. A1011 – Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
14. B62 – Standard Specification for Composition Bronze or Ounce Metal Castings
15. B88 – Standard Specification for Seamless Copper Water Tube
16. B96 – Standard Specification for Copper-Silicon Alloy Plate, Sheet, Strip, and Rolled Bar for General Purposes and Pressure Vessels
17. B763 – Standard Specification for Copper Alloy Sand Castings for Valve Applications
18. B843 – Magnesium Alloy Anodes for Cathodic Protection
19. C33 – Standard Specification for Concrete Aggregates
20. C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates
21. C150 – Standard Specification for Portland Cement
22. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
23. C1227 – Standard Specification for Precast Concrete Septic Tanks
24. D429 – Standard Test Methods for Rubber Property-Adhesion to Rigid Substrates
25. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kn-m/m3))
26. D1241 – Standard Specification for Materials for Soil-Aggregate Subbase, Base, and Surface Courses

27. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
28. D1330 – Standard Specification for Rubber Sheet Gaskets
29. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
30. D1784 – Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
31. D1785 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
32. D2000 – Standard Classification System for Rubber Products in Automotive Applications
33. D2239 – Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
34. D2241 – Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
35. D2467 – Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
36. D2454 – Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
37. D2737 – Standard Specification for Polyethylene (PE) Plastic Tubing
38. D2774 – Standard Practice for Underground Installation of Thermoplastic Pressure Piping
39. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
40. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
41. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
42. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
43. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
44. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
45. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
46. D3950 – Standard Specification for Strapping, Nonmetallic (and Joining Methods)
47. D4253 – Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table
48. D4254 – Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
49. D6938 – Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth)
50. E8 – Standard Test Methods for Tension Testing of Metallic Materials
51. F412 – Standard Terminology Relating to Plastic Piping Systems
52. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
53. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
54. G97 – Standard Test Method for Laboratory Evaluation of Magnesium Sacrificial Anode Test Specimens for Underground Applications

B. American Water Works Association (AWWA)
1. B300 – Standard for Hypochlorites
2. B301 – Standard for Liquid Chlorine
3. B302 – Standard for Ammonium Sulfate
4. B303 – Standard for Sodium Chlorite
5. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
6. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
7. C110 – Standard for Ductile-Iron and Gray-Iron Fittings
8. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

9. C115 – Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
10. C116 – Standard for Protective Fusion-Bonded Epoxy Coatings for Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings
11. C150 – Standard for Thickness Design of Ductile-Iron Pipe
12. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
13. C153 – Standard for Ductile-Iron Compact Fittings
14. C200 – Standard for Steel Water Pipe 6 In. (150 mm) and Larger
15. C203 – Standard for Coal-Tar Protective Coatings & Linings for Steel Water Pipes
16. C206 – Standard for Field Welding of Steel Water Pipe
17. C207 – Standard for Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)
18. C213 – Standard for Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings
19. C214 – Standard for Tape Coatings for Steel Water Pipelines
20. C219 – Standard for Bolted, Sleeve-Type Couplings for Plain-End Pipe
21. C500 – Standard for Metal-Seated Gate Valves for Water Supply Service
22. C502 – Standard for Dry-Barrel Fire Hydrants
23. C504 – Standard for Rubber-Seated Butterfly Valves
24. C509 – Standard for Resilient-Seated Gate Valves for Water Supply Service
25. C515 – Standard for Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service
26. C550 – Standard for Protective Epoxy Interior Coatings for Valves and Hydrants
27. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
28. C604 – Standard for Installation of Buried Steel Water Pipe – 4 In. (100 mm) and Larger
29. C605 – Standard for Underground Installation of Polyvinyl Chloride (PVC) and Molecularly Oriented Polyvinyl Chloride (PVCO) Pressure Pipe and Fittings
30. C651 – Disinfecting Water Mains
31. C700 – Standard for Cold-Water Meters – Displacement Type, Metal Alloy Main Case
32. C800 – Standard for Underground Service Line Valves and Fittings
33. C900-2016 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 60 In. (100 mm Through 1,500 mm) for Water Transmission and Distribution
34. C901 – Standard for Polyethylene (PE) Pressure Pipe and Tubing 1/2 In. (13 mm) Through 3 In. (76 mm) for Water Service
35. C906 – Polyethylene (PE) Pressure Pipe and Fittings 4 in. (100 mm) Through 63 In. (1,600 mm) for Water Distribution and Transmission
36. M11 – Steel Pipe: A Guide for Design and Installation
37. M17 – Standard for Installation, Field Testing, and Maintenance of Fire Hydrants
38. M23 – Standard for PVC Pipe Design and Installation
39. M41 – Standard for Ductile-Iron Pipe and Fittings

C. Colorado Department of Transportation (CDOT)

D. National Fire Protection Agency (NFPA)

E. Occupational Safety and Health Administration (OSHA)

F. NSF International:
1. Standard 60 – Drinking Water Treatment Chemicals – Health Effects
2. Standard 61 – Drinking Water System Components – Health Effects

G. Surface Preparation Standards (SSPC)

H. American Welding Society (AWS):
1. D1.1 – Structural Welding Code – Steel

I. National Association of Corrosion Engineers (NACE):
1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines

J. Uni-Bell PVC Pipe Association:
1. Uni-Pub-8: Tapping Guide for PVC Pressure Pipe

K. Plastics Pipe Institute (PPI):
   1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
   2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
   3. Handbook of Polyethylene Pipe
   4. Material Handling Guide

L. Ductile Iron Pipe Research Association (DIPRA):
   1. Thrust Restraint Design for Ductile Iron Pipe

M. American Railway Engineering and Maintenance-Of-Way Association (AREMA)

N. International Plumbing Code (IPC)

O. International Code Council (ICC)

P. Underwriters' Laboratories (UL)

1.04 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications

C. Shop Drawings: Provide sufficient data to verify compliance with the specifications and to illustrate construction and assembly of precast vault

D. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight. Indicate pressure ratings for pipe, fittings, valves
   1. Pipe materials
   2. Special, fitting, and coupling details
   3. Joint restraint system
   4. Valves
   5. Laying and installation schedule
   6. Specifications and data sheets
   7. Affidavits of compliance for protective shop coatings and linings

E. Product Data: Provide manufacturer catalog information on castings, grating, and accessories to indicate compliance with specifications of precast vault

F. Design Data: Include calculations prepared by precast manufacturer indicating design loads and material requirements for reinforcement

G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.

H. Test Reports: Submit reports of field pressure and disinfection tests under provisions of Section 01 33 00 Submittal Procedures and Section 01 33 19 Field Test Reporting.

I. Test Reports: Indicate disinfection results comparative to specified requirements

J. Submit under provisions of Division 1 Specifications

K. Accurately record actual locations of piping mains, valves, connections, top of pipe elevations, and any mapped or unmapped utilities

L. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

M. Disinfection report; record:
   1. Type and form of disinfectant used
   2. Date and time of disinfectant injection start and time of completion
   3. Test locations
   4. Initial and 24 hour disinfectant residuals (quantity in treated water) in parts per million (ppm) or milligram per liter (mg/L) for each outlet tested
   5. Date and time of flushing start and completion
   6. Disinfectant residual after flushing in ppm for each outlet tested

N. Bacteriological report; record:
   1. Date issued, project name, and testing laboratory name, address, and telephone number
   2. Time and date of water sample collection
   3. Name of person collecting samples
   4. Test locations
   5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested
   6. Coliform bacteria test results for each outlet tested
   7. Bacteriologist's signature and authority

1.05 QUALITY ASSURANCE

A. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years

B. All ductile iron pipe, regardless of diameter, shall be supplied by a single manufacturer

C. Perform Work in accordance with AWWA C651, and the Colorado Department of Public Health and Environment, CDPHE, Jefferson County and West Jefferson Metropolitan District.

D. Contractor shall conduct visual inspection before installation

E. Provide manufacturer's name and pressure rating marked on piping and valves

F. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational water lines

1.06 REGULATORY REQUIREMENTS

A. Conform to all municipal codes and ordinances, laws and regulations of Jefferson County, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit

B. Conform to AWWA C651, as appropriate, and CDPHE Design Criteria for Potable Water Systems for performing the work of this Section

C. In case of apparent conflict, CDPHE requirements govern over these specifications

D. In absence of State and local regulations, International Plumbing Code applies

E. NFPA Compliance: Install fire water systems in accordance with NFPA 24 “Standard for the Installation of Private Fire Service Mains and Their Appurtenances”

F. UL Compliance: Provide fire hydrants that comply with UL 246 “Hydrants for Fire-Protection Service,” and are listed by UL.

G. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 specifications

B. Delivery
   1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct sunlight

C. Storage
   1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: direct sunlight, mud, etc.
   2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
   3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
      a. Do not stack pipe higher than 5 feet

D. Storage: Use the following precautions for valves, during storage:
   1. Do not remove end protectors unless necessary for inspection; then reinstall for storage
      a. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

E. Handling
   1. Handle so as to insure installation in sound undamaged condition
   2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection.
   3. Use hooks or straps with broad, well-padded contact surfaces for lifting sections of pipe

F. Preparation for Transport: Prepare valves, for shipping as follows: Ensure that valves are dry and internally protected against rust and corrosion. Protect valves against damage to threaded ends, flange faces, and weld ends. Set valves in best position for handling. Set valves closed to prevent rattling

G. Deliver and store valves and accessories in shipping containers with labeling in place in accordance with AWWA C500

H. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation

I. Seal valve ends to prevent entry of foreign materials into valve body

J. During loading, transporting and unloading, exercise care to prevent damage to material
   1. Use nylon slings only
   2. Do not drop pipe or fittings
   3. Do not roll or skid against pipe already on ground
   4. Repair any damage done to coating or lining
   5. Handle per manufacturer's recommendations
   6. Store rubber gaskets in cool dark location
   7. Store all material on wood pallets or timbers

K. Adequately tag or otherwise mark all piping, fittings, and valves as to size per AWWA C509 and C900

L. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner

M. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner

1.08 JOB CONDITIONS

A. All work which requires the interruption of active water service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the Jefferson County, West Jefferson Metropolitan District and coordinated as specified in Division 1

B. Underground Obstructions
   1. Underground Obstructions known to Engineer are shown on Drawings
      a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
      b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
   2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
   3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
      a. Notify Engineer and Owner in case of a conflict
      b. In case of a conflict, the proposed work may be changed by Engineer
   4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

C. Verify existing system operation, pressures, and valve settings (open or closed) prior to construction

PART 2 PRODUCTS

2.01 PIPE, FITTINGS, AND ACCESSORIES

A. Comply with the most current Evergreen Metropolitan District Rules and Regulations for the public water system products and accessories.

2.02 DUCTILE IRON PIPE

A. Manufacturers
   1. U.S. Pipe
   2. American Cast Iron Pipe Company
   3. Griffin Pipe Products Company
   4. Or accepted substitution

B. The following piping and fittings shall be ductile iron pipe as indicated on Drawings and as specified herein:
   1. Fire Hydrant piping: 6" diameter
   2. Piping under Railroad: 12” diameter
   3. Fittings, joints, couplings, and mechanical joints

C. Pipe: ANSI A21.51/AWWA C151:
   1. Class 51, pressure rating 350 psi
   2. For push-on joints, mechanical joints, restrained mechanical joints, or restrained joints: Class 51, single gasket
   3. Lining: cement mortar, AWWA C104
   4. External coating for buried pipe: asphaltic coating, 1 mil

D. Fittings: Ductile iron compact fittings: ANSI A 21.53/AWWA C153
   1. Working pressure rating: 350 psi rating
   2. Joint: Mechanical joints with restraints
   3. Coating:
      a. Exterior: AWWA C111, Asphalt coated
      b. Interior: AWWA C104 and C111, lined with double thickness cement seal coated
      c. Or interior and exterior: AWWA C116, fusion bonded epoxy coating
   4. Tapping Sleeve and Tapping Valve: Complete assembly, including tapping sleeve, tapping valve, and bolts and nuts. Use sleeve and valve compatible with tapping machine.
      a. Tapping Sleeve: Cast-iron or ductile-iron 2-piece bolted sleeve with flanged outlet for new branch connection. Sleeve may have mechanical joint ends with rubber gaskets or sealing rings in sleeve body. Use sleeves that mate with size and type of pipe material being tapped. Outlet flange shall be of a size required for branch connection.

E. Joints
   1. Mechanical joints: ANSI A21.11/AWWA C111
      a. Bolts and nuts: High strength, low alloy steel, "Cor-Ten" or approved substitution
   2. Mechanical joints with tie rods
      a. Tie rods: ASTM A307, galvanized entire length
      b. Steel pipe spacers: ASTM A53 , standard weight galvanized
      c. Washers: ASTM A27 plain steel, galvanized
      d. Plastic plugs: As recommended by pipe manufacturer
   3. Push-on joints: ANSI A21.11/AWWA C111
      a. Pressure rated 350 psi
      b. Lubricant: Heavy vegetable soap solution suitable for potable water contact
   4. Gaskets: EPDM gaskets in conformance with AWWA C111. Natural rubber is not acceptable.
   5. Gaskets: Butyl rubber gaskets in conformance with ANSI A21.11/AWWA C111. Natural rubber is not acceptable.
      a. Pressure rated 350 psi
   6. Threaded connections: ANSI B1.20.3 NPT: provide boss or tapping saddle at all tapped connections
   7. Mechanical couplings:
      a. Dresser, Style 38
      b. Rockwell, 411
      c. Romac, 501
      d. Or accepted substitution

8. Insulated Mechanical Couplings:
    a. Dresser, Style 39
    b. Rockwell, Style 416
    c. Romac, IC501
    d. Or accepted substitution
9. Mechanical joints with restraint device
    a. Provided for all ductile iron fittings
    b. 360° serration lock engagement type
    c. Nuts and bolts torqued to requirements of manufacturer
    d. Working pressure rated at 350 psi minimum
    e. Glands color coded: Black
    f. Manufacturers:
        i) EBBA Iron Inc., Meg-a-Lug Series 1100
        ii) Uni-Flange Corporation, 1400 Series
        iii) Romac Industries Inc., RomaGrip™
        iv) Or accepted substitution

2.03 SERVICE LINE ACCESSORIES

A. Corporation Stops: AWWA C800, Bronze body and ground key plug. Threaded inlet and outlet matching service piping material
    1. Bronze body and ground key plug. Threaded inlet and outlet matching service piping material.
    2. Manufacturers:
        a. Mueller, H-15013
        b. Ford, FB1000G
        c. A.Y. McDonald, 4701BQ or 4701BT
        d. Or accepted substitution

B. Curb Stops: 2" bronze body and ground key plug. Threaded inlet and outlet matching service piping material.
    1. Manufacturers:
        a. Mueller
        b. Ford
        c. Or accepted substitution

C. Curb box: Arch pattern base, coal tar coated extensions. Include 1 inch tapped hole with a centered plug having a 5/8-inch hexagon nut. Include cover with lettering “WATER.”
    1. Manufacturers:
        a. A.Y. McDonald, 5607 with 5601-1 lid
        b. Or accepted substitution

D. Service Clamps: Complete assembly, including double strap service clamp, corporation stop, and bolts and nuts. Use service clamp and stop compatible with drilling machine.
    1. Cast iron or ductile iron with gasket and AWWA C800 threaded outlet for corporation stop, and threaded end straps.
    2. Manufacturers:
        a. Mueller Co.
        b. Romac Industries, Inc.
        c. Or accepted substitution

2.04 CATHODIC PROTECTION

A. Polyethylene encasement
    1. Provide encasement for all ductile iron pipe, fittings, restrained mechanical joints and valves
    2. High-density, cross-laminated polyethylene film (minimum 4 mil) or linear low-density polyethylene film (min 8mil)
    3. Polyethylene flat tube: meet appropriate minimum width for size of pipe installed per AWWA C105, Method A, secured with polyethylene compatible adhesive tape

4. Flat sheet polyethylene: Provide wrapping odd shaped appurtenance following C105, secured with polyethylene compatible adhesive tape
5. Joint tape: Self-sticking, PVC or polyethylene, 2-inch wide, 10 mils thick
    a. Manufacturer:
        i) Chase "Chasekote 750"
        ii) Kendall "Polyken 900"
        iii) 3M "Scotchrap 50"
        iv) Or accepted substitution
6. Strapping: Nonmetallic, water resistant, ASTM D3950

B. Field applied tape encasement: AWWA C214
1. Primer: Polyken #927
2. Tape: Polyken #930 or #934
3. Apply primer and Polyken wrap for harness rods

2.05 PIPE ACCESSORIES

A. Identification Marker Tape: Provide metallic core tape, blue with black letters “CAUTION – WATER LINE BELOW” continuously printed plastic tape with metallic core, intended for direct-burial service; not less than 6-inch wide x 4 mils thick. Provide identification markers of one of the following:
1. Allen Systems, Inc.
2. Emed Co., Inc.
3. Seton Name Plate Corp.
4. Or accepted substitution

B. Tracer Wire
1. Provide tracer wire for all Ductile Iron pipe
2. All tracer wire shall be 12 AWG solid copper wire coated with 45 mil Type HMW - PE blue insulation compliant with ASTM D1351 specifically designed for direct burial in corrosive soil or water
3. UL listed

C. Tracer Wire Test Stations
1. 4-inch with locking lid
2. Manufacturers:
    a. CP Test Services
    b. Glenn Series "Glenn-4"
    c. Or accepted substitution

D. Corrosion Control
1. Rust inhibitive primer:
    a. Tnemec "Series 77H Chem-Prime"
    b. Or accepted substitution
2. Rust preventative compound:
    a. Houghton "Rust Veto 344"
    b. Rust-Oleum "R-9"
    c. Or accepted substitution

2.06 GATE VALVES – 3" TO 12" AND ACCESSORIES

A. Manufacturers:
1. Mueller
2. American AVK
3. American Flow Control
4. Clow
5. Kennedy
6. Or accepted substitution

B. AWWA C509, Iron body, bronze trim, two O-ring stem seals, non-rising stem with square nut, single wedge, resilient seat, mechanical joint ends, extension stem, and extension valve box, pressure rating of 250 psi. For installation in horizontal or near horizontal pipe lines

1. Non-adjustable elastomeric stem seals
    a. Adjustable packing glands are not permitted
2. Direct operation of stem from above via 2-inch square nut
    a. No gear box provided
3. Rotation: Counterclockwise to open with the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut

C. Rotation: Contractor to verify the operating direction with the jurisdictional water district or department
1. Provide the word "OPEN" and an arrow indicating the direction to open cast on valve body or operating nut.
2. Contractor to confirm nut size with the jurisdictional water district or department

D. Valve stem material: ASTM B763, UNS alloy C99500 minimum yield strength of 40,000 psi
1. Valve stem extensions: Provide valve stem extensions as necessary for proper valve operation with a 7 foot key with tee handle
2. Provide one (1) key to Owner prior to project closeout

E. Extension stems
1. Provide for buried valves with operating nuts more than 4.5 feet below grade
2. Non-rising stems
    a. Solid steel shafting with O.D. not less than O.D. of valve stem or galvanized steel pipe with I.D. not less than O.D. of valve stem
    b. Connected to the valve by a flexible socket coupling
    c. All other connections pinned
    d. Extend stem to within 6-inch of grade
    e. Provide spacers to center stem in valve box
    f. Provide wrench nut

F. Coating
1. AWWA C550 and NSF 61 certified
2. Minimum 8 mils dry film thickness
3. Fusion bonded epoxy applied to all ferrous metal surfaces after cleaning surfaces of grease, dirt and moisture, and performing near-white blast cleaning following SSPC-SP10
4. Do not coat fasteners or machined surfaces subject to contact and relative movement against other surfaces during operation of valve or other surfaces where such coating would compromise proper installation or functionality of valve

G. Valve boxes, depth as required for valve
1. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch
2. Box, cover, and base coated by dipping in asphalt varnish.
3. Cover marked with word, “WATER.”
4. Provide extension piece to permit 6-inch adjustment above finish grade
5. Manufacturers:
    a. Tyler Pipe Company "Series 6860 with #160 oval base"
    b. East Jordan Iron Works "8560 Series"
    c. Tyler Union "6860 Series"
    d. Or accepted substitution

2.07 FIRE HYDRANT

A. Fire hydrants to be provided for installation where indicated on the Drawings

B. Manufacturers:
1. American AVK
2. Kennedy Valve
3. Or accepted substitution

C. General
1. Fire hydrants shall meet or exceed AWWA C502; latest revision

2. Hydrants shall be manufactured and tested in ISO 9001 certified facility
3. Fire hydrants shall be rated for a working pressure of 250 psi
4. A Higbee cut (blunt start) will be provided on the lead thread of the outlet nozzles, nozzle caps, seat ring, drain ring, and thrust nut.
5. Fire hydrants shall be of the compression type, opening against system pressure and closing with system pressure

D. Main Valves and Drain
1. The main valve and drain shall be of one piece construction and completely encapsulated with EPDM.
2. Fire hydrants shall have a minimum 5-1/4 main valve opening.
3. Fire hydrants shall open left and be clearly marked.
4. The EPDM shall be permanently vulcanized to the main valve.
5. The main valve shall provide complete closing of the drains after 4 to 5 turns.
6. During initial stages of opening, the drains shall momentarily flush outward to remove any debris in the drain ports, in order to provide complete draining upon closing of the hydrant main valve.
7. The drain ring assembly shall be replaceable without removing the hydrant from the connecting pipe or having to dig.
8. Valve facings shall be of nontoxic materials suitable for potable water service.

E. Stems
1. Upper hydrant stems shall be made of stainless steel
2. Hydrant shall have one breakaway flange and stem coupling located 3-inches above finished grade.

F. Operating Nut
1. Operating nuts shall be one-piece bronze design with upper and lower anti-friction washers for ease of operation.
2. A protective weather shield shall be installed over the operating nut.
3. Operating nut shall be 1-1/2 inch and pentagon shape

G. Nozzles
1. Pumper nozzles shall be 4-1/2 inch NH / NST threaded.
2. Fire hydrants shall have two 2-1/2 inch hose connection outlets NH/NST threaded.
3. Nozzles shall be of the 1/4 turn bayonet lug style, secured with a stainless steel locking screw.
4. Caps shall have 1-1/2 inch pentagon shape nuts.
5. Nozzle caps shall be chained to hydrant.

H. Lubrication
1. A lubrication port shall be provided for application of lubricant without disassembly of the bonnet section.
2. The reservoir shall be filled with NSF/FDA approved food grade grease or oil at the manufacture’s facility.
3. Valve stem seals shall be an o-ring type with not less than two o-rings below the thrust nut and two o-rings above the thrust nut.
4. O-ring and gaskets shall be made of an NBR rubber to help prevent the effects of permeation.

I. Protective Coatings
1. All ferrous parts except the lower barrel and those parts made of stainless steel shall be fusion bonded epoxy coated yellow
2. All epoxy coatings shall meet the requirements of ANSI/AWWA C550 (latest edition).
3. The lower barrel shall be bitumen coated both internally and externally.
4. A bury line shall be marked on the lower barrel below the break flange to indicate proper installation depth. Bury depth will be clearly stenciled on the standpipe section.
5. Shop paint exterior of hydrants red

J. Shoe
1. End connections shall be 6 inch mechanical joint unless specified
2. Mechanical joints shall comply with AWWA C111

K. Break Flange and Couplings
   1. All fire hydrants shall be of the traffic Breakaway type and allow 360-degree rotation of the fire hydrant to position the pumper nozzle in the desired direction
   2. The break flange segments shall be located under the upper barrel flange to prevent the segments from falling into the lower barrel when the hydrant is struck

L. Warranty
   1. All fire hydrants shall be covered by a manufactured warranty for a minimum of 10 years for defects

M. Hydrant Gravel: Hydrant gravel shall be well graded crushed stone or gravel, conforming to AASHTO #67 gradation as listed below:

Sieve Size	Percent Passing
1”	100
3/4”	90-100
3/8”	20-55
No. 4	0-10
No. 8	0-5

2.08 CORROSION CONTROL

A. Shop paint all ferrous metal surfaces of valves and accessories, both interior and exterior for corrosion protection, epoxy interior coating for potable water contact.

B. Manufacturer's standard paint will be acceptable if it is functionally equivalent and compatible with specified field coatings

C. Exterior bituminous coating or asphalt varnish: Manufacturer's Standard epoxy coal tar

D. Ductile-iron Pipe and Fittings Shop lining: Cement-lined, AWWA C104/C205

E. Rust inhibitive primer: Tnemec "Series 77H Chem-Prime" or accepted substitution

F. Rust preventative compound: Houghton "Rust Veto 344", Rust-Oleum "R-9", or accepted substitution

2.09 BEDDING

A. Bedding: As specified in Section 31 00 00

2.010 ACCESSORIES – MISCELLANEOUS

A. Extension stems
   1. For valve installations with operating nuts over 5 five below grade, extend stem to 4.5 feet of final grade. Provide spacers to center stem in valve box.
   2. Three piece cast iron (complying with ASTM A48, Class 20A) adjustable screw type, 5.25-inch diameter, minimum thickness of 3/16 inch.
   3. Box, cover, and base coated by dipping in asphalt varnish.
   4. Cover marked with word, “WATER.”
   5. Provide threaded top section to permit 6-inch adjustment above finish grade.
   6. Series 6860 with #160 oval base as manufactured by Tyler Pipe Company or accepted substitution.

B. Concrete for Thrust Blocks: constructed of “Class B” Concrete as defined by CDOT Construction Specifications with maximum water to cement ratio of 0.63 by weight and 28-day compressive strength of 3,000 psi

C. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
   1. Clamps, straps and washers: Steel, ASTM A506
   2. Rods: Steel, ASTM A575
   3. Rod Couplings: Malleable-iron, ASTM A197
   4. Bolts: Steel, ASTM A307

5. Cast-Iron Washers: Gray-iron, ASTM A126

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify existing conditions under provisions of Division 1 Specifications

B. Verify locations and inverts or tops of pipe for connections to existing system as well as crossings with other utilities as indicated on the drawings. Report any discrepancies to Engineer

C. Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation

D. Remove all defective piping from site and replace

E. Examine areas for weak or structural defects or deviations beyond allowable tolerances for piping clearances that adversely affect excavation and quality of Work

F. Start installation only when conditions are satisfactory

G. Verify items provided by other sections of Work are properly sized and located

3.02 PERFORMANCE - GENERAL

A. Perform work in a safe and proper manner with appropriate precautions against hazard

B. Provide adequate working space and clearances for work performed within excavations and for installation and removal of utilities

C. Contain all construction activity on the designated site and within the limits of work. Cost of restoration of site will be the responsibility of the Contractor

D. Contractor to verify quantities to perform all earthwork required according to Drawings, including but not limited to, additional import or export required to handle compaction, pavement subgrade preparation, and pipe bedding

E. Contractor shall take precautions to limit the removal of or damage to existing pavements, multi-use paths sidewalks, curbs, lawns, shrubbery, trees, hedges, walls, fences, buildings, or other existing improvements to the least practicable amounts and shall replace or restore such improvements to their original location and condition after the excavation has been backfilled and compacted

3.03 PROTECTION OF EXISTING UTILITIES AND STRUCTURES

A. Excavation and backfill operations shall be performed in such a manner to prevent cave-ins of excavations or the undermining, damage or disturbing of existing utilities and structures or of new work

B. Backfill shall be placed and compacted so as to prevent future settlement or damage to existing utilities and structures and new work

C. Any excavations improperly backfilled or where settlement occurs shall be reopened to the depth required then refilled with approved materials and compacted, and the surface restored to the required grade and condition, at no additional costs to the Owner

D. Any damage due to excavation, backfilling, or settlement of the backfill, or injury to persons or damage to property occurring as a result of such damage shall be the responsibility of the Contractor. All costs to repair such damage, in a manner satisfactory to the Engineer, shall be borne by the Contractor at no additional expense to the Owner

3.04 SITE PREPARATION

A. Clear all site areas within the limits of work of grasses, roots, brush, and other objectionable material and debris

B. Remove all waste materials from site and dispose. Stockpile all acceptable grubbings for reuse in revegetation areas.

C. Remove debris including all demolished trees, underbrush, stumps, roots and other combustible materials from site and dispose of off-site; on-site burning is not permitted

3.05 DEWATERING

A. Comply with CDPHE Dewatering Requirements

B. Dewatering discharge to surface waterways requires CDPHE dewatering permit. Contractor must obtain dewatering permit and comply with discharge requirements therein, if necessary

3.06 PIPE PREPARATION

A. Ream pipe and tube ends and remove burrs

B. Remove scale and dirt, on inside and outside, before assembly

C. Cut ends of metallic pipe, recoat with coating approved for potable water service and compatible with manufacturer's coatings.

3.07 BEDDING

A. Comply with West Jefferson County Metropolitan District standards and specifications

B. Excavate pipe trench in accordance with Section 31 00 00 for work of this Section. Do not disturb trench bottom during excavation. Hand trim excavation for accurate placement of pipe to elevations indicated.

C. Place bedding material in accordance with Section 31 00 00 at trench bottom, level fill materials in one continuous layer not exceeding 6 inches compacted depth, compact to 95 percent. Protect from lateral displacement by placing embedment evenly on both sides of pipe

D. Provide dewatering and backfill trench in accordance with Section 31 00 00

3.08 PIPE INSTALLATION

A. Comply with West Jefferson County Metropolitan District standards and specifications. Use the manufacturer’s recommendations if the West Jefferson County Metropolitan District standards do not specifically apply.

B. Install PVC Pipe in accordance with AWWA M23 and AWWA C605

C. Install Ductile Iron Pipe in accordance with AWWA C600

D. Install Ductile Iron Fittings in accordance with AWWA M41

E. Route pipe as indicated on the Drawings

F. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected

G. Install as specified or in accordance with the manufacturer's recommendations

H. Cutting Pipe
   1. Cut pipe to measurement taken at the site, not from the drawings
   2. Cut pipe neatly without damage to pipe
   3. Cut smooth, straight, and at right angles to pipe axis
   4. Dress and bevel end of cut pipe to remove roughness and sharp corners
   5. Cut pipe with saw or abrasive wheel
   6. Follow state and federal safety regulations pertaining to cutting asbestos concrete pipe as necessary

I. Provide an isolation or shutoff valve and union at the water connections to each fixture and unit of equipment, whether shown on the drawings or not

J. Install pipe to indicated elevations. Maintain minimum 4.0 feet depth of ground cover and maintain minimum grade for drainage. Establish elevations of buried piping to ensure minimum cover is achieved. Maximum depth of 7.0 feet is allowed to avoid a local high point unless shown otherwise on the plans. Add additional soil in areas of future fill to provide minimal cover at all times. Report any variations from plan to Owner and Engineer
   1. Provide air release valve at all high points and blow-offs or hydrant at all low points. Coordinate locations and details with Engineer.

2. Where minimum depth cannot be maintained, provide a minimum of 2 inch of specified insulation board per 1 foot of cover not provided. Contractor must have Owner and Engineer approval prior to installation.
    a. Place insulation board over bedding material for the width of the trench

K. Install pipe to allow for expansion and contraction without stressing pipe or joints

L. Protect from lateral displacement by placing embedment evenly on both sides of pipe

M. Do not lay pipe in water. Maintain groundwater level a minimum of 12 inches below pipe to be installed. Do not lay pipe under unsuitable weather or trench conditions

N. Make changes in horizontal, vertical, and curved alignment shown on drawings by using joint deflections in the amount permissible by manufacturer and shown on drawings

O. Do not bend pipe

P. Deflect pipe at joints

Q. Do not deflect PVC pipe at connection to ductile iron fittings

R. Form and place concrete for thrust blocks at each elbow or change of direction of pipe main as indicated on Drawings

S. Utility crossings
1. Whenever possible, lay water mains over sanitary and storm sewers to provide vertical separation of at least 18-inch between invert of water main and crown of sewer
2. If standard crossing detail is not available and above separation cannot be met, provide one continuous length of watertight sewer pipe 20' long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inch either side of joint or encase sewer pipe in 6-inch of concrete completely around pipe, for not less than 10' either side of water main
3. Water Mains Passing Under Sanitary Sewers: If vertical separation is less than 18-inch, provide structural support for sewer. Provide concrete encasement where water lines pass under sanitary sewer line. Reference detail shown on Drawings

T. Maintain a minimum 10 feet of horizontal separation and 18 inches of vertical separation between water main and storm or sanitary sewer lines in accordance with the CDPHE
1. Provide concrete encasement if these clearances cannot be achieved and when water line is below sanitary sewer line

U. Tracer wire and marker tape
1. Install tracer wire continuous over top of pipe
2. Install tracer wire test stations at maximum 500 LF of water line per West Jefferson County Metropolitan District requirements. Locate test station at fire hydrants, gate valves, or special test station locations in a valve box
3. Terminate tracer wire following drawing details
4. Tape tracer wire to top of pipe using PVC tape every 4 feet along the pipe, and on each side of fitting
    a. Tape: minimum 2 inches wide and wrapping full circumference of pipe
5. Install identification /warning marker tape in fill area of trench above all water lines

V. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system

W. Install access fittings to permit disinfection of water system, subject to approval by Engineer

X. Backfill trench in accordance to specifications herein

Y. Protect pipe from floatation or movement until completely backfilled and put into service

3.09 WATER MAIN CONNECTIONS

A. Comply with Jefferson County, West Jefferson Metropolitan District, standards and specifications. Coordinate Jefferson County, West Jefferson Metropolitan District and fire department representatives for any impacts to the existing water system and provide advanced notice to impacted properties if applicable.

B. Connect to water main per plans and referenced standards or details.

3.010 JOINTS

A. Make pipe joints carefully and neatly

B. Connect piping in accordance with manufacturer's recommendations

C. Push-on joints
   1. Lay pipe with bell ends facing the direction of laying except when Engineer authorizes reverse laying
   2. Assembly of PVC plain end into bell: follow PVC pipe manufacturer's recommendation
   3. For PVC pipe, Contractor to ensure that pipe is not inserted into the bell ends beyond the push line
      a. Utilize EBAA Mega-Stop bell protection, or approved substitution, if necessary, to ensure previously laid pipe joints are not impacted by ongoing installation
   4. Lubricate joint surfaces immediately before completing the joint
   5. Bevel spigot ends of field cut piping
   6. Groove spigot ends of field cut restrained joint piping if required by joint system
   7. Install restrained joints following manufacturer's recommendations

D. Mechanical joints
   1. Before assembling joint, clean both bell and plain end of rust and foreign matter
   2. Assemble joint following AWWA C111, C600, C605 and as specified
   3. Lubricate gasket and install in accordance with manufacturer's instructions
   4. If an effective seal is not obtained, disassemble joint, clean thoroughly, and reassemble
   5. Do not over tighten bolts to compensate for poor installation
   6. Carefully align holes in mechanical joints with restraint device to permit installation of the harness bolts
   7. Install mechanical joint pieces so the mechanical joint holes straddle the top centerline for horizontal piping, or the side centerline for vertical piping

3.011 PROTECTIVE COATING

A. Provide polyethylene tube encasement on all buried ductile iron fittings, valves, and fire hydrant extensions
   1. Encase ductile iron fittings and valves in polyethylene per AWWA C105, Method A, secured with polyethylene compatible adhesive tape. Overlap polyethylene onto PVC pipe a minimum of 6 inches
   2. Before backfilling, inspect polyethylene for rips, punctures and other damage and repair following AWWA C105

B. Coat exposed ferrous metal surfaces of joints, couplings, and uncoated steel with primer and tape coating system after installation. Do not coat stainless steel or high strength low alloy steel nuts and bolts
   1. Surface Preparation: Clean surfaces of rust, scale, soil, mud, oil, grease, and other contaminants by hand or power tool following SSPC-SP2 or SP3 and other appropriate means as recommended by coating manufacturer Remove excess moisture and provide surface dryness as recommended by coating manufacturer
   2. Application: Apply primer in uniform manner to clean and dry surfaces following coating manufacturer's recommendations
      a. Fill complex and irregular surfaces with appropriate mastic or filler tape to eliminate bridging; then apply tape/wrap to primed and filled surfaces following coating manufacturer's recommendations.
      b. When coating restraining rods or strapping, apply tape wrap longitudinally

c. Where metal being coated enters concrete, overlap coating onto concrete by minimum of 2 inches after placement of concrete

3. Inspection: After field coating of specified items, conduct visual inspection to verify complete coverage has been accomplished.
   a. Repair damaged or incompletely coated surfaces following coating manufacturer's recommendations

3.012 VALVES AND HYDRANTS INSTALLATION

A. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards

B. Center and plumb valve box over valve. Set box cover flush with finished grade.
   1. Backfill and compact under and around valve boxes to ensure no vertical loads are transmitted to valve operators or bonnets

C. Comply with AWWA M17 for fire hydrant installation. Install with gate valve and provisions for drainage

D. Install valves, hydrants, and accessories in accordance with the manufacturer's recommendations and in accordance with referenced standards and specifications.

E. Hydrants and valves to be set plumb on solid bearing surface

F. Locate hydrant flange a minimum of 3” and maximum 6” above adjacent finished grade or flush with the adjacent top of curb. Contractor to verify final grade or adjust flange height upon the completion of final grading

G. Drainage shall be provided at the base of the hydrant by placing rock from the bottom of the trench to at least 12 inches above the barrel flange of the hydrant and to a distance of 12 inches around the elbow. The minimum distance from the bottom of the trench to the bottom of the hydrant elbow shall be 6 inches. The minimum amount of rock placed shall be 1/3 cubic yard

3.013 VALVE INSTALLATION

A. Comply with Jefferson County, West Jefferson Metropolitan District standards and specifications

B. Carefully inspect valve before installation. Clean interior. Operate valve to determine parts in proper working order, with valves seating and drain valve operating properly. Set plumb and center stem in valve box and securely brace into place. Comply with AWWA C600 and referenced standards.

C. Provide concrete collar for installations within landscaped areas

D. Protect valve box and cover during paving operations and clean any excess concrete, or asphalt, or road base from valve box and cover to ensure visibility and proper operation

3.014 THRUST BLOCKS

A. Installation:
   1. Thrust blocks shall be constructed at bends and fittings that require support due to unbalanced line thrust. Care shall be taken to ensure that outlets, cover bolts, nuts, clamps, and other fittings are accessible. A bond breaker shall be placed between the pipe and the thrust block to aid in future removal. If a large thrust block is to be placed, it shall be separated into sections by a suitable material. Bearing surface areas are minimum areas to bear against the undisturbed trench wall. If the soil bearing capacity is insufficient to provide adequate support based on minimum bearing areas established by Drawing Details, then the minimum bearing area shall be increased to a size that shall ensure support restraint. In every instance, the thrust block shall bear against undisturbed earth
   2. Before placing concrete, equipment used in the mixing and transport shall be cleaned. Debris, water, or ice shall be removed from the area to be occupied by concrete. Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the Owner or Engineer unless inspection is waived prior to the placement

B. Formwork for Thrust blocks:

1. Forming for concrete thrust blocks and anchors shall be done by bulkheading around the shape of the thrust block or anchor with wood, burlap sacks, or reinforced paper sacks that are filled with sand or earth. Sacks shall be constructed of a size easily handled when full and left in place in the trench. Wood forms shall be removed before backfilling.
2. Horizontal struts or braces required for trench shoring shall not remain in concrete thrust blocks. Prior to placing concrete, the forms and ditch bank will be inspected and approved by Owner or Engineer
3. When concrete is deposited against the ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water in from the concrete

C. Thrust block Curing Time:
1. Newly placed concrete shall be allowed to set undisturbed for a minimum of 24 hours

D. Compaction of Fill Over Thrust blocks
1. Backfill may be placed over thrust blocks once the surface has set sufficiently and they are able to resist the weight of the backfill. However, tamping or compacting shall not be allowed above the thrust block for a minimum of 24 hours after placement

E. Hydrostatic testing shall not be conducted until thrust blocks have fully cured, a minimum of 7 days

3.015 ABANDONMENT

A. Cap ends of main as shown. Place required concrete blocking as shown on drawing details

B. Where mains are to be abandoned and removed to a fitting or valve, cut and plug main at fitting or valve
1. When shown on drawings, remove fire hydrants and valves, including lead joint tees when encountered; salvage and deliver removed fire hydrants and valves to the Jefferson County, West Jefferson Metropolitan District
2. Pipe, fittings, and other appurtenances that are removed, but are not required to be salvaged become property of Contractor
   a. Remove and dispose of offsite

3.016 ERECTION TOLERANCES

A. Establish invert elevations as shown on the drawings

B. Construct pipe within manufacturer’s tolerances of horizontal and vertical deflection. Refer to Jefferson County, West Jefferson Metropolitan District for allowable deflections at joints and fittings.

3.017 FIELD QUALITY CONTROL

A. Comply with Jefferson County, West Jefferson Metropolitan District standards and specifications. Test each line at the Contractor's expense in the presence and to the satisfaction of Jefferson County, West Jefferson Metropolitan District inspectors.

B. Field inspection and testing will be performed under provisions set forth by the referenced standards

C. Test each line at the Contractor's expense in the presence and to the satisfaction of Owner or Engineer at a maximum of 1,000 foot intervals

D. Water Line Disinfection
1. Comply with AWWA C651 and provide Engineer and Owner with results.
2. Flush water lines prior to disinfection, except when tablet method is used. Acceptable chlorine disinfectants are calcium hypochlorite granules, sodium hypochlorite solutions, and calcium hypochlorite solutions, and calcium hypochlorite tablets.
3. After the pipe is filled with water and chlorine, the chlorinated water shall be held in contact with the pipe for 24 hours. At the end of the 24 hour period, the water in the pipeline shall be tested by the local health authority having jurisdiction, or their designated representative, to ensure a residual chlorine content in compliance with Jefferson County, West Jefferson Metropolitan District requirements. The pipeline shall then be thoroughly flushed to remove the heavily chlorinated water. This activity requires a permit from the CDPHE WQCD prior to flushing. Comply with all provisions of the permit. Care shall be taken in flushing the pipeline to prevent property damage and danger to

the public. Discharges of water from blowoff assemblies or other appurtenances shall be contained or discharged in a manner approved by Jefferson County, West Jefferson Metropolitan District and the CDPHE.

4. For fire lines, flush piping complying with NFPA 24
5. If water in pipe does not meet the governing agency requirements, repeat disinfection procedure until acceptable. Furnish copies of acceptance forms from governing agency to Owner and Engineer.

E. Valve Testing
   1. Conduct pressure and leakage tests on all newly installed valves
   2. Furnish all necessary equipment and material and make all connections to the pipe, as required. The Engineer shall monitor the tests.

F. Hydrostatic Pressure Tests
   1. Provide all necessary pumping equipment, piping connections, pressure gauges with maximum of 5 psi increments, and other required equipment, facilities, and materials
   2. All water used for pressure testing must be potable and delivered in acceptable containers
   3. Immediately locate and replace all pipe fittings, valves, pipe joints, and other materials found to be defective with new and acceptable material
   4. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner
   5. Procedure
      a. Disconnect all fixture devices and other accessories which may be damaged by the specified test pressure
      b. Plug or cap ends as required
      c. Bleed system to eliminate all air from system
      d. No pressure testing shall be permitted until all concrete thrust blocks have adequate curing time to reach design strength, 7 day minimum
      e. Notify Owner and Engineer 48 hours prior to testing
      f. Test for 2 hours with no more than 5 psi pressure loss
      g. Leakage is the quantity of water added to a test section to maintain test pressure ±5 psi:

$$L = \frac{S \times D \times (P)^{0.5}}{133{,}200}$$

Where:
L = allowable leakage in gallons per hour
S = length of pipe tested, in feet
D = nominal diameter of pipe, in inches
P = average test pressure during test, psig

   6. Hydrostatic Test Conditions: At lowest point in the line or section under test pressure or operating pressure, whichever is greater, as scheduled below

Pipe	Test Pressure	Operating Pressure	Test Medium	System
18-inch PVC	150 psi	100 psi	Water	Distribution
12-inch PVC	150 psi	100 psi	Water	Distribution
12-inch DIP	150 psi	100 psi	Water	Distribution
8-inch PVC	150 psi	100 psi	Water	Distribution
6-inch PVC	150 psi	100 psi	Water	Distribution
6-inch DIP	150 psi	100 psi	Water	Distribution/Hydrant
PE 3608 CTS	150 psi	100 psi	Water	Distribution/Service

   7. While the test pressure is maintained, an examination shall be made of the pipeline and any leaks located and repaired. Pipe or fittings found to be faulty shall be removed and replaced. Leakage is

not allowed through the bonnet of the line valve. A valve leaking through the bonnet may be repaired in place or removed and replaced. Cutting and replacement of pavement as well as excavation and backfilling may be necessary when locating and repairing leaks discovered during pressure testing.

8. After visible leaks are stopped, repeat procedure beginning at 3.13.D.5 of this section

G. PVC Water Pipe Continuity Testing
   1. Test tracer wire for continuity, in the presence of Owner and Engineer, after backfill is complete and before Substantial Completion
   2. Notify Owner and Engineer five working days in advance to schedule testing
   3. Continuity test to consist of locating the PVC water pipe with an electronic-type pipe locator
   4. If test is negative for continuity, repair or replace as necessary to achieve continuity

H. Bac-T Testing
   1. After completion of water line disinfection as specified in Section 33 13 00, Contractor shall take Bac-T samples to ensure pipe has been properly disinfected and submit results to Engineer
   2. If water line fails Bac-T sampling, any repeat disinfection and Bac-T testing will be at the Contractor's expense
   3. The Contractor shall receive Jefferson County, West Jefferson Metropolitan District approval before placing a water line in service

3.018 CLEANING

A. Verify that piping has been cleaned and inspected

B. Verify that piping has been successfully pressure tested and flushed

C. Perform scheduling and disinfection activity with start-up, testing, adjusting, demonstration procedures, including coordination with related systems

3.019 DISINFECTION

A. Provide and attach required equipment to perform the work of this Section

B. Tablet, continuous, or slug disinfection may be followed in accordance with AWWA C651

C. The preferred method is continuous disinfection, summarized as follows:
   1. Inject treatment disinfectant, free chlorine in liquid form into piping system to obtain 50 to 80 ppm residual
   2. Bleed water from outlets to ensure distribution and test for disinfectant residual
   3. Maintain disinfectant in system for 24 hours
   4. If final disinfectant residual tests less than 25 ppm, repeat treatment
   5. Flush, circulate and clean until residual equal to that of incoming potable water or 1.0 mg/L is achieved

D. Replace permanent system devices removed for disinfection

3.020 FINAL FLUSHING

A. Maintain a flushing velocity of 2.5 feet per second in piping

B. Collect chlorinated water for proper disposal and/or dechlorinate to less than 0.1 ppm free chlorine prior to discharge in accordance with State, County, and local regulations

3.021 DISINFECTION FIELD QUALITY CONTROL

A. After final flush, and before main or equipment is placed in service, collect water samples from representative points along the main and field test for chlorine residual

B. Chlorine residual shall be within 50 percent of the chlorine residual prevailing in the source

C. If initial disinfection fails to provide satisfactory samples, repeat disinfection until satisfactory samples have been obtained

3.022 DISINFECTION TESTING AND ACCEPTANCE

A. The Contractor will perform Bacteriological (Bac-T) sampling and testing after pipes have been disinfected and flushed as specified herein

B. If any portion of the piping or equipment or tanks fails Bac-T testing, the Contractor is responsible for repeating disinfection procedures until passing Bac-T test is obtained

3.023 FINAL ACCEPTANCE

A. Comply with Jefferson County, West Jefferson Metropolitan District standards and specifications for placing water line in service

B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
   1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete

C. Drain all test water from the new pipe system prior to placing in service

D. Provide water tap locations (x, y, z) shown on the Drawings

E. Provide operation and maintenance manuals for air and line valves and fire hydrants

F. Provide final reports to Engineer for:
   1. Bac-T results
   2. Residual chlorine tests
   3. Hydrostatic tests for each section or pipe
   4. Cathodic protection system test(s)
   5. Tracer wire continuity test

END OF SECTION

SECTION 33 33 00
SANITARY SEWERAGE UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Polyvinyl chloride (PVC) non-pressure pipe for gravity sanitary sewer with all jointing materials, fittings, and other appurtenances required for a complete installation

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 33 19 – Field Test Reporting

C. Section 01 78 23 – Operation and Maintenance Data

D. Section 31 00 00 – Earthwork

1.03 REFERENCES

A. American Society for Testing and Materials (ASTM):
1. A48 – Standard Specification for Gray Iron Castings
2. A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
3. A185 – Standard Specification for Welded Steel Wire Fabric for Concrete Reinforcement
4. A307 – Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength
5. A615 – Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
6. C33 – Standard Specification for Concrete Aggregates
7. C150 – Standard Specification for Portland Cement
8. C443 – Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
9. C478 – Standard Specification for Circular Precast Reinforced Concrete Manhole Sections
10. C497 – Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile
11. C913 – Standard Specification for Precast Concrete Water and Wastewater Structures
12. C923 – Standard Specification for Resilient Connectors Between Reinforced Concrete manhole Structures, Pipes, and Laterals
13. C1227 – Standard Specification for Precast Concrete Septic Tanks
14. C1619 – Standard Specification for Elastomeric Seals for Joining Concrete
15. C1821 – Standard Practice for Installation of Underground Circular Precast Manhole Structures
16. D698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
17. D1248 – Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
18. D1330 – Standard Specification for Rubber Sheet Gaskets
19. D1351 – Standard Specification for Thermoplastic Polyethylene Insulation for Electrical Wire and Cable
20. D1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC)
21. D1785 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
22. D2122 – Standard Test Method for Determining Dimensions of Thermoplastic Pipe and Fittings
23. D2240 – Standard Test Method for Rubber Property – Durometer Hardness
24. D2321 – Standard Specification for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications
25. D2466 – Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
26. D2774 – Standard Specification for Underground Installation of Thermoplastic Pressure Piping
27. D2837 – Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products
28. D3034 – Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings

29. D3035 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
30. D3139 – Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
31. D3212 – Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
32. D3261 – Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
33. D3350 – Standard Specification for Polyethylene Plastics Pipe and Fittings Materials
34. F412 – Standard Terminology Relating to Plastic Piping Systems
35. F477 – Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
36. F714 – Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
37. F679 – Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings
38. F1055 – Standard Specification for Electrofusion Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene and Crosslinked Polyethylene (PEX) Pipe and Tubing
39. F2164 – Standard Specification for Field Leak Testing of Polyethylene (PE) and Crosslinked Polyethylene (PEX) Pressure Piping Systems Using Hydrostatic Pressure

B. American Water Works Association (AWWA):
1. C104 – Standard for Cement-Mortar Lining for Ductile-Iron Pipe and Fittings
2. C105 – Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
3. C111 – Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
4. C115 – Standard for Flanged Ductile-Iron Pipe with Ductile-Iron or Grey-Iron Threaded Flanges
5. C150 – Standard for Thickness Design of Ductile-Iron Pipe
6. C151 – Standard for Ductile-Iron Pipe, Centrifugally Cast
7. C504 – Standard for Rubber-Seated Butterfly Valves
8. C512 – Standard for Air Release, Air/Vacuum, and Combination Air Valves for Water and Wastewater Service
9. C600 – Standard for Installation of Ductile Iron Mains and Their Appurtenances
10. C900 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. Through 12 In. (100 mm Through 300 mm), for Water Transmission and Distribution
11. C905 – Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 In. Through 48 In. (350 mm Through 1,200 mm), for Water Transmission and Distribution
12. M23 – PVC Pipe: Design and Installation

C. Colorado Department of Transportation (CDOT)

D. Occupational Safety and Health Administration (OSHA)

A. American Welding Society (AWS):
1. D1.1 – Structural Welding Code – Steel

B. National Association of Corrosion Engineers (NACE):
1. SP0169 – Control of External Corrosion on Underground or Submerged Metallic Piping Systems
2. SP0286 – Electrical Isolation of Cathodically Protected Pipelines

C. Plastics Pipe Institute (PPI):
1. TR-4 – HDB / HDS / SDB / PDB / MRS Ratings for Thermoplastic Piping Materials or Pipe
2. TR-33 – Generic Butt Fusion Joining Procedure for Field Joining of Polyethylene Pipe
3. Handbook of Polyethylene Pipe
4. Polyethylene Piping Systems Field Manual for Municipal Water Applications
5. Material Handling Guide

1.04 SUBMITTALS

A. Submit under provisions of Division 1 Specifications

B. Shop Drawings: Provide piping layout and assembly drawings with fitting dimensions. Provide sufficient information to verify compliance with specifications

C. Product Data: Provide manufacturer's catalog information with dimensions, material and assembled weight.
   1. Pipe materials
   2. Special, fitting, and coupling details
   3. Gasket materials
   4. Valves
   5. Laying and installation schedule
   6. Specifications and data sheets
   7. Affidavits of compliance for protective shop coatings and linings

D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements and applicable standards. Provide prior to shipment.

E. Test Reports: Submit reports of field exfiltration/infiltration, mandrel and lamp tests under provisions of Division 1 Specifications

F. TV Inspection Files: Submit videos and reports

1.05 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1 Specifications

B. Accurately record actual locations of piping mains, valves, connections, invert elevations, and any mapped or unmapped utilities

C. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities

1.06 QUALITY ASSURANCE

A. Perform Work in accordance with Jefferson County, West Jefferson Metropolitan Districtand CDPHE Stormwater and/or Groundwater Discharge Permit, notes on the drawings and as specified herein.

B. Manufacturers shall be experienced in the design and manufacturing of materials specified herein for a minimum period of 5 years

C. All PVC pipe, regardless of diameter, shall be supplied by a single manufacturer

D. Perform Work in accordance with the Colorado Department of Public Health and Environment (CDPHE) and Jefferson County

E. Contractor shall conduct visual inspection before installation

F. Provide manufacturer's name and pressure rating marked on piping and valves

G. Provide piping complete with all fittings, jointing materials, supports, joint restraint system, and necessary appurtenances for watertight, fully operational sewer lines

1.07 REGULATORY REQUIREMENTS

A. Conform to all municipal codes and ordinances, laws and regulations of Jefferson County, West Jefferson Metropolitan District, CDPHE, the notes and details on the drawings and as specified herein, and CDPHE Stormwater Management and/or Construction Dewatering Permit

B. In case of apparent conflict, CDPHE requirements govern over these specifications

C. Contractor, not Owner, shall prepare, submit, pay, and otherwise obtain all necessary permits from all appropriate entities

1.08 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Division 1 Specifications

B. During loading, transporting and unloading, exercise care to prevent damage to material
   1. Use nylon slings only
   2. Do not drop pipe or fittings
   3. Do not roll or skid against pipe already on ground

4. Repair any damage done to coating or lining
5. Handle per manufacturer's recommendations
6. Store rubber gaskets in cool dark location
7. Store all material on wood pallets or timbers

C. Shop coated materials shall be handled, transported, stored and shipped in a manner that will prevent damage to the coating and lining. Coating or lining damaged in handling or other operations shall be repaired to the approval of and at no additional cost to the Owner

D. Any damage to the pipe or the protective coating from any cause during the installation of the pipeline and before final acceptance by the Engineer shall be repaired in accordance with these Specifications and at no additional cost to the Owner

E. Pipe
1. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation
2. PVC pipe has reduced flexibility and impact resistance as temperatures approach and drop below freezing. Extra care should be used in handling PVC pipe during cold weather
3. Do not store PVC pipe uncovered in direct UV light
4. Pipe stored along the trench side shall be suitably supported off the ground to avoid damage to the coating

F. Valves
1. Prepare valves for shipping as follows:
   a. Ensure that valves are dry and internally protected against rust and corrosion
   b. Protect vales against damage to threaded ends, flange faces, and weld ends
   c. Seal valve ends to prevent entry of foreign materials into valve body
   d. Set valves in best position for handling
   e. Set valves closed to prevent damage
2. Deliver and store valves and accessories in shipping containers with labeling in place
3. Storage: Use the following precautions for valves during storage:
   a. Do not remove end protectors unless necessary for inspection; then reinstall for storage
   b. Protect valves from weather by storing indoors or support valves off ground or pavement in watertight enclosures when outdoor storage is necessary

G. Precast Concrete Structures
1. Transport and handle precast concrete units with equipment to protect from dirt and damage
2. Do not place precast concrete units in position which will cause damage
3. Handle precast concrete structures by means of lifting inserts. Do not move from manufacturer’s yard until curing is complete.

1.09 JOB CONDITIONS

A. All work which requires the interruption of active sanitary sewer service lines must be completed as quickly as possible in order to minimize inconvenience to customers and risk to the Jefferson County, West Jefferson Metropolitan District, and coordinated as specified in Division 1

B. Underground Obstructions
1. Underground Obstructions known to Engineer are shown on Drawings
   a. Locations shown may prove inaccurate and other obstructions not known to Engineer may be encountered
   b. Contractor shall field locate and verify all obstructions where or not shown on the Drawings
2. Notify each utility owner and request utility be field located by surface reference at least 48 hours prior to trenching or excavation
3. Expose and verify size, location and elevation of underground utilities and other obstructions where conflicts might exist sufficiently in advance to permit changes in the event of a conflict
   a. Notify Engineer and Owner in case of a conflict
   b. In case of a conflict, the proposed work may be changed by Engineer
4. Maintain, protect, and support by shoring, bracing or other means existing utilities and appurtenances

PART 2 PRODUCTS

2.01 PIPE, MANHOLES, AND ACCESSORIES

A. Comply with Jefferson County, West Jefferson Metropolitan District standards and specifications.

PART 3 EXECUTION

3.01 INSPECTION

A. Examine pipe and fittings and do not use individual sections containing cracks, dents, abrasions, and other defects

3.02 INSTALLATION OF HDPE PRESSURE PIPE

A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 31 00 00

B. Pipe and Fittings
   1. Follow pipe manufacturers installation instructions for field cutting and fusion joining techniques for HDPE pipe
      a. Include acceptable size and shape of fusion bead; and minimum radius of curvature of various sizes of pipe for installing curved sections of pipe
   2. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
   3. Do not dump or drop pipe or accessories into trench
   4. Lay to lines and grades indicated on drawings or as specified
      a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
      b. Join to form a smooth flow line
   5. Do not install flanges, fittings, or valves in curved sections of pipe
   6. Keep pipe clean during and after laying
   7. Close all open ends with watertight expandable type sewer plugs or test plugs
   8. Do not lay pipe when
      a. There is water in the trench
      b. Trench conditions are unsuitable
      c. Weather conditions are unsuitable
   9. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
   10. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 31 00 00
   11. Protect pipe from hot and cold thermal expansion using manufacturer and other recommended techniques
   12. HDPE pipe by Horizontal Directional Drilling (HDD): Refer to Section 33 05 23.13

C. Joining
   1. Use butt fusion joining technique for connections between pipe sections or fittings unless otherwise noted herein.
   2. Butt Fusion
      a. Sections of polyethylene pipe should be joined into continuous lengths on the jobsite above ground.
      b. The joining method shall be the butt fusion method and shall be performed in strict accordance with the pipe manufacturer’s recommendations.
      c. The butt fusion equipment used in the joining procedures should be capable of meeting all conditions recommended by the pipe manufacturer.
      d. The butt fusion joining will produce a joint weld strength equal to or greater than the tensile strength of the pipe itself.
   3. Sidewall Fusion
      a. Sidewall fusions for connections to outlet piping shall be performed in accordance with HDPE pipe and fitting manufacturer’s specifications.

b. The heating irons used for sidewall fusion shall have an inside diameter equal to the outside diameter of the HDPE pipe being fused.
c. The size of the heating iron shall be ¼ inch larger than the size of the outlet branch being fused.

4. Mechanical
   a. Bolted joining may be used where the butt fusion method cannot be used.
   b. Flange joining will be accomplished by using a HDPE flange adapter with a ductile iron back-up ring.
   c. Mechanical joint joining will be accomplished using either a molded mechanical joint adapter or the combination of a Sur-Grip Restrainer and Pipe Stiffener as manufactured by JCM Industries, Inc.
   d. Either mechanical joint joining method will have a ductile iron mechanical joint gland.
5. Other
   a. Socket fusion, hot gas fusion, threading, solvents, and epoxies may not be used to join HDPE pipe.

D. Water Line and Sanitary Sewer Crossings
1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer

3.03 INSTALLATION OF PVC GRAVITY SANITARY SEWER PIPE (NON-PRESSURE)

A. Trenching, Pipe Embedment, Backfill, and Compaction: See Section 31 00 00

B. Install pipe in accordance with ASTM D2321 as modified herein or on the drawings

C. Cutting
1. Cut and bevel ends in accordance with manufacturer's standard recommendations
2. Machine cut ends smooth and square to proper dimensions
3. Do not cut with a cold chisel, iron pipe cutter, flame or any other method that may fracture the pipe or leave ragged, uneven edges
4. Remove burrs and wipe off all dust and dirt from jointing surfaces

D. Pipe Laying
1. Inspect pipe and accessories for cracks and other defects before lowering into trench
2. Repair or replace any defective, damaged or unsound pipe
3. Remove all dirt and foreign material from the inside of pipe before laying
4. Check bedding for firmness and uniformity of surface immediately before laying each section of pipe
5. Carefully lower pipe, fittings, valves, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage
6. Do not dump or drop pipe or accessories into trench
7. Lay to lines and grades indicated on drawings or as specified
   a. Lay piping beginning at a low point of system, true to line and grade with unbroken continuity of invert.
   b. Closely joint to form a smooth flow line
   c. Place bell end or groove ends of piping facing upstream
   d. Maximum length of pipe that can be used without exceeding the allowable deflection at a coupling shall be determined
   e. Maximum deflection at flexible couplings as recommended by the manufacturer
   f. Maximum deflection at a joint: As recommended by the manufacturer, but not more than 3-1/2 inches
8. Utilize implements, tools, and facilities as recommended by the manufacturer
9. Keep pipe clean during and after laying

10. Close all open ends with watertight expandable type sewer plugs or test plugs
11. Remove and relay any pipe which has floated
12. Do not lay pipe when
    a. There is water in the trench
    b. Trench conditions are unsuitable
    c. Weather conditions are unsuitable
13. Use acceptable adaptors at manhole and structure connections to provide a watertight seal and flexibility; provide a short length of pipe outside each connection
14. Protect from lateral displacement by placing and compacting bedding material under provisions of Section 31 00 00

E. Jointing
1. Assemble in accordance with the manufacturer's instructions
2. Wipe clean pipe ends, gasket and gasket groove before inserting gasket
3. Apply lubricant furnished by the pipe manufacturer to the gasket and the outside of the spigot end
4. Utilize an assembly tool as recommended by the manufacturer to center the sleeve over the spigot end
5. Insert the spigot end to the reference mark
6. Check gasket location after assembly with a suitable gage
    a. Gasket locations to be the distance from the sleeve and recommended by the coupling manufacturer for their full circumference
    b. If not within the required limits, disassemble and reassemble the joint

F. Fittings
1. Install utilizing standard methods
2. Lower into trench with rope or other means to prevent damage
3. Attach rope around the exterior
4. Do not attach rope through the interior
5. Carefully connect to pipe or other facility
6. Check joint to insure a sound and proper joint

G. Water Line and Sanitary Sewer Crossings
1. Whenever possible lay water mains over sanitary sewers to provide vertical separation of at least 18-inches between invert of water main and crown of sewer.
2. If above separation cannot be met, provide one continuous length of watertight sewer pipe 20 feet long centered on water main with joints between different pipes encased in 6-inch minimum of concrete and extending 6-inches either side of joint or encase sewer pipe in 6-inches of concrete completely around pipe, for not less than 10 feet either side of water main.
3. Water Mains Passing Under Sewers: If vertical separation less than 18-inches provide structural support for sewer

3.04 CONNECTION TO EXISTING MANHOLES

A. Maintain flow at all times

B. Prior approval of proposed method for maintaining flow must be obtained from Engineer

C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure

D. Make connection during low flow periods

3.05 FIELD QUALITY CONTROL – PIPE

A. General
1. Utilize pressures, media and pressure test durations as specified on Piping Schedules
2. Isolate equipment which may be damaged by the specified pressure test conditions
3. Perform pressure test using calibrated pressure gauges and calibrated volumetric measuring equipment to determine leakage rates. Select each gauge so that the specified test pressure falls within the upper half of the gauge's range. Notify Engineer 24 hours prior to each test
4. Completely assemble and test new piping systems prior to connection to existing pipe systems

5. Acknowledge satisfactory performance of tests and inspections in writing to Engineer prior to final acceptance
6. Provide all necessary equipment and perform all work required in connection with the tests and inspections
7. Bear the cost of all testing and inspecting, locating and remedying of leaks and any necessary retesting and re-examination

B. Testing methods and criteria
1. Ductile iron pipe systems: Test ductile iron pipe in accordance with the latest version of AWWA C600. Per AWWA C600, the allowable leakage in gallons per hour from buried ductile iron pipe systems shall be less than the length of pipeline tested in feet, times the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be two hours. The equation for computing the allowable leakage is:

   i) $L = (SDP^{0.5})/133,200$
   Where:
   L = allowable leakage, in gallons per hour
   S = length of the pipe tested, in feet
   D = nominal diameter of the pipe, in inches
   P = average test pressure during the leakage test, in psi

2. Polyethylene (PE) pressure pipe systems: Test PE pressure pipe in accordance with the latest version of ASTM F2164. For PE pipe, pressurize the test section to the system test pressure and maintain this pressure for four hours by adding make-up water. After this initial expansion phase, reduce the test pressure by 10 PSI and stop adding make-up water. If the test pressure remains steady (within 5% of the target value) for one hour, no leakage is indicated
3. Unless otherwise specified, the allowable leakage in gallons per hour from other buried liquid piping systems shall be less than the length of pipeline tested in feet, times the nominal diameter of the pipe in inches, times the square root of the average test pressure during the leakage test in pounds per square inch (gauge), divided by 133,200. The duration of each leakage test shall be two hours. The equation for computing the allowable leakage is:

   i) $L = (SDP^{0.5})/133,200$
   Where:
   L = allowable leakage, in gallons per hour
   S = length of the pipe tested, in feet
   D = nominal diameter of the pipe, in inches
   P = average test pressure during the leakage test, in psi

4. The following liquid piping systems shall have zero allowable leakage at the specified test pressure throughout the specified duration:
   a. Exposed piping
   b. Buried insulated piping
   c. Buried or exposed piping carrying liquid chemicals
5. Hydrostatic pressure testing
   a. For buried piping: Perform testing after backfill and proper compaction of trenches. Where lines are installed under roadways and parking areas, perform tests after completion of final grade preparation and prior to application of surface courses. Notify Engineer at least 48 hours prior to testing. Provide temporary restraints for expansion joints for additional pressure load under test. Isolate equipment in piping system with rated pressure lower than pipe test pressure by valves or blind flanges
6. Low pressure air test
   a. Check pneumatic plugs for proper sealing
   b. Place plugs in line at each manhole and inflate to 25 PSIG

c. Introduce low pressure air into sealed line segment until air pressure reaches 4 PSIG greater than ground water that may be over the pipe. Use test gauge conforming to ANSI B40.1 with 0 to 15 PSI scale and accuracy of 1 percent of full range
d. Allow 2 minutes for air pressure to stabilize
e. After stabilization period (3.5 PSIG minimum pressure in pipe) discontinue air supply to line segment
f. Acceptable time for loss of 0.5 PSIG of air pressure in plastic pipe shall be:

	Minimum Time for 0.5 PSIG Loss in Plastic Pipe (minutes: seconds)								
Pipe	≤100	150	200	250	300	350	400	450	500
4 Inch	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53	1:53
6 Inch	2:50	2:50	2:50	2:50	2:50	2:50	2:51	3:12	3:34
8 Inch	3:47	3:47	3:47	3:47	3:48	4:26	5:04	5:42	6:20
10 Inch	4:43	4:43	4:43	4:57	5:56	6:55	7:54	8:54	9:53
12 Inch	5:40	5:40	5:42	7:08	8:33	9:58	11:24	12:50	14:14
15 Inch	7:05	7:05	8:54	11:08	13:21	15:35	17:48	20:02	22:16
18 Inch	8:30	9:37	12:49	16:01	19:14	22:26	25:38	28:51	32:03
21 Inch	9:55	13:05	17:27	21:49	26:11	30:32	34:54	39:16	43:38
24 Inch	11:24	17:57	22:48	28:30	34:11	39:53	45:35	51:17	56:59
27 Inch	14:25	21:38	28:51	36:04	43:16	50:30	57:42	64:54	72:07
30 Inch	17:48	26:43	35:37	44:31	53:25	62:19	71:13	80:07	89:02

NOTE: If there has been no (zero psi) drop after 1 hour of testing, the test section shall be accepted and the test completed

h. For pipe lengths not shown in the above table, use the two nearest pipe lengths to estimate the minimum time necessary for a 0.5 PSIG loss
i. For concrete pipe 24" and smaller refer to ASTM C-924 for acceptable test procedures and times
j. For concrete pipe 24" and larger refer to ASTM C-1103 for acceptable test procedures and times

7. Hydrostatic Exfiltration/Infiltration Test
   a. Hydrostatic Exfiltration Test (groundwater level is below the top of pipe)
      i) Allowable Leakage rate: 50 gallons per IN diameter per mile of pipe per day
   b. Hydrostatic Infiltration Test (groundwater level is above the top of pipe)
      i) Allowable leakage rate: 50 gallons per IN diameter per mile of pipe per day
8. Notify Engineer of the date and time for each pipe test 1 week prior to actual testing

C. Exfiltration/Infiltration Test
1. Perform an exfiltration test on each reach of sanitary service and sewer pipe between manholes or discharge
   a. Test the first reach prior to backfilling and before installing any of the remaining pipe
   b. Provide all necessary piping between the reach to be tested and the water supply, together with all required materials and equipment
   c. Methods used, scheduling, and duration of tests shall be acceptable to Engineer
   d. Air testing may be allowed: Submit complete information to Engineer for review describing the proposed test method including the method of testing manholes before beginning testing
2. Procedure
   a. Block off all manhole openings except those connecting with the reach under test
   b. Fill the line
      i) Average depth: 10 feet above invert except as required by manhole depth
      ii) Maximum depth at lower end: 25 feet above crown
      iii) Minimum depth at upper end: 5 feet above crown

c. Add and measure water as required to maintain a constant level
   i) Maximum exfiltration/infiltration: 0.039 gallons per inch of nominal diameter per hour per 100 feet of pipe.
   ii) Manholes considered section of 48-inch pipe
   iii) Maintain test for at least 2 hours or as long as necessary, in the inspector's opinion, to locate all leaks

3. Repair and retest any reach which exceeds the allowable exfiltration/infiltration

D. Infiltration
1. At any time prior to expiration of the correction period, infiltration exceeds 0.039 gallons per inch of nominal diameter per 100 feet per hour, locate the leaks and make repairs

E. Dielectric Testing Methods and Criteria
1. Provide electrical check between metallic non-ferrous pipe or appurtenances and ferrous elements of construction to assure discontinuity has been maintained
2. Wherever electrical contact is demonstrated by such test, locate the point or points of continuity and correct the condition
3. Check the integrity of each cadwelding connection using a light hammer blow at a 45-degree angle

F. Pipe Deflection Test
1. No sooner than 30 days after placement and compaction of backfill, but prior to placement of permanent surface materials, clean and mandrel each line to detect obstructions (deflections, joint offsets, lateral pipe intrusions, etc.)
2. Use a rigid mandrel with diameter of at least 95 percent of the pipes specified average inside diameter and a length of the mandrel circular portion at least equal to the nominal pipe diameter
3. Maximum allowable deflection is 5 percent of the base internal diameter. Mandrel outside diameters in inches are as follows:

Pipe Size	Base I.D.	Mandrel O.D.
6	5.792	5.50
8	7.764	7.38
10	9.711	9.23
12	11.558	10.98

4. Pull the mandrel through the pipe by hand
5. Relay or replace all pipe exceeding the 5 percent deflection at no additional cost to the Owner
6. Retest repaired sections
7. Maximum allowable deflection at end of one year correction period, 7-1/2 percent of the base internal diameter tested in the same manner. Uncover and repair sections exceeding the allowable deflection

G. TV Inspection will be provided as requested by Owner and approved by the Engineer at the expense of the Contractor. Digital video files to be provided with reach noted, footage, inverts, and manhole number at each end, and pipe size and type [CHECK WITH MUNICIPALITY]

H. All sewer lines shall be inspected visually to verify accuracy of alignment and freedom from debris and obstructions. The full diameter of the pipe should be visible when viewed between consecutive manholes. The method of test can be photography, closed circuit television or visually lamping with mirrors and lights.

I. Lamp Test
1. Each section between manholes will be lamped by Contractor in the presence of engineer
2. A true circle will be required in the lamp tests to indicate a properly constructed sewer line
3. Repair any sections not passing the lamp test at Contractor's expense.

3.06 FIELD QUALITY CONTROL – MANHOLES

A. Test all manholes:

1. Vacuum test:
   a. Plug all inlets and outlets in such a manner as to prevent displacement of plugs
   b. Install and operate vacuum tester head assembly in accordance with equipment specifications and manufacturer instructions
   c. Attach the vacuum pump assembly to the proper connection on the test head assembly. Ensure that vacuum inlet/outlet valve is closed
   d. Inflate sealing element to twice the pressure test to be used. Do not over inflate
   e. Start vacuum pump assembly engine and allow preset RPM to stabilize
   f. Open vacuum inlet/outlet valve and evacuate manhole to 5-inches Hg (mercury)
   g. Close vacuum inlet/outlet valve, disconnect vacuum pump and monitor vacuum. Record time for vacuum to drop from initial 5 inches Hg to 4 inches Hg.
   h. Acceptance for 5 foot diameter manhole is when the time to drop from 5 inches Hg to 4 inches Hg meets or exceeds requirements as defined below:

Maximum Allowable Vacuum Drop		
Manhole Depth Rim to Invert	**Manhole Diameter in feet**	**Time for Vacuum to Drop 1 inch Hg**
10 feet or less	5	150 seconds
10 feet to 15 feet	5	180 seconds
15 feet to 25 feet	5	210 seconds

   i. Adjust time to drop from 5 inches Hg to 4 inches Hg for other manhole diameters as follows:
      i) 4 foot diameter manhole: Subtract 30 seconds from time shown above
      ii) 6 foot diameter manhole: Add 30 seconds to time shown above
   j. Repair all manholes that fail leakage test and retest until manhole passes test at no additional cost
   k. If joint mastic or gasket is displaced during vacuum test, disassemble manhole and replace seal
   l. If the manhole fails the initial test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn, Retesting shall proceed until a satisfactory test is obtained.
2. All testing shall be witnessed by Engineer. Contractor shall provide a minimum of 48 hours notice to Engineer prior to testing.

3.07 CLEANUP AND RESTORATION

A. Restore pavements, curbs and gutters, utilities, and other improvements to condition equal to or better than before work began and to satisfaction of Engineer.

B. Deposit waste material in designated waste areas and disposal site graded and shaped.

3.08 FINAL ACCEPTANCE

A. Comply with Jefferson County, West Jefferson Metropolitan District standards and specifications for placing sewer line in service

B. The inside of all pipe, valves, and fittings shall be smooth, clean, and free from blisters, loose mill scale, sand, and dirt when connected.
   1. Wire brush, if necessary, wipe clean and keep joint contact surfaces clean until connection is complete

C. Provide record drawings with manhole number, inverts, and location (x, y, z) for each service connection

D. Provide test report for tracer wire continuity

E. Provide pipe and manhole tests and results

F. Provide video files of TV inspection on a DVD

END OF SECTION

SECTION 33 40 00
STORM DRAINAGE SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Piping and concrete structures for storm sewer system, roof drainage, and culverts

B. Riprap for channel lining, outlet protection and rock check dams

1.02 RELATED SECTIONS

A. Section 01 33 00 – Submittal Procedures

B. Section 01 33 19 – Field Test Reporting

C. Section 01 78 23 – Operation and Maintenance Data

D. Section 31 00 00 – Earthwork

1.03 REFERENCES

A. ACPA - American Concrete Pipe Association

B. ASTM C76 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe

C. ASTM C150 - Portland Cement

D. ASTM C443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets

E. ASTM C478 – Precast Concrete Structures

F. ASTM C497 - Testing Concrete Pipe, Manhole Sections, or Tile

G. ASTM A48 - Gray Iron Castings

H. ASTM A185 - Steel Welded Wire Fabric, Plain, for Concrete Reinforcement

I. ASTM A615 - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

J. ASTM C33 - Concrete Aggregates

K. ASTM C478 - Precast Reinforced Concrete Manhole Sections

L. ASTM C990 – Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants

M. ASTM D2321 – Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications

N. ASTM D3212 – Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals

O. ASTM F477 – Elastomeric Seals (Gaskets) for Joining Plastic Pipe

P. ASTM F2881 – 30 to 60 in. [762 to 1500 mm] Polypropylene (PP) Dual Wall Pipe and Fittings for Non-Pressure Storm Sewer Applications

Q. Urban Storm Drainage Criteria Manual, Mile High Flood District (MHFD), previously known as Urban Drainage and Flood Control District (UDFCD)

R. Colorado Department of Transportation (CDOT) Standard Specifications for Road and Bridge Construction

1.04 DESIGN REQUIREMENTS

A. Comply with applicable requirements of ASTM C76

B. Comply with applicable requirements of ASTM D2321

C. Comply with Jefferson County, Urban Storm Drainage Criteria Manual, Mile High Flood District (MHFD), previously known as Urban Drainage and Flood Control District (UDFCD), and Colorado Department of Public Health and Environment (CDPHE) Stormwater and/or Groundwater Discharge Permit and related storm design criteria. If standards conflict, the more stringent criteria shall govern.

1.05 SUBMITTALS

A. Submit under provisions of Division One Specifications

B. Shop Drawings: Provide drawings with pipe and structure details, design standards, reinforcement, dimensions, etc. Provide additional detailed information (including elevations, fittings, specialty materials or fabrications, etc.) for special or custom features, structures, junctions and/or pipes. Provide pipe-laying schedule.

C. Product Data: Provide sufficient data on features, pipe, joints, gasket material, lubricant and accessories to verify compliance with specifications.

D. Manufacturers Certificate: Certify that pipe, meets or exceeds specified requirements. Confirm all materials comply with applicable standards.

E. Test Reports: Submit all shop and field test reports in accordance with Division One Specifications

F. Provide sufficient data to verify compliance with these specifications.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Delivery
   1. Ship rubber gaskets in cartons and store in a clean area away from grease, oil, ozone producing electric motors, heat and the direct rays of the sun

B. Storage
   1. Store pipe, fittings and gaskets in clean locations protected from environmental conditions such as: (direct sunlight, mud, etc.)
   2. Do not use pipe and fittings stored in direct sunlight for periods in excess of 18 months
   3. Store pipe on a flat surface which provides even support for the barrel with bell ends overhanging
      a. Do not stack pipe higher than 5 feet
   4. All pipe and fittings shall be delivered to the site and unloaded with handling that conforms to the manufacturer's instructions for reasonable care. Pipe shall not be rolled or dragged over gravel or rock during handling. The Contractor shall take necessary precautions to ensure the method used in lifting or placing the pipe does not induce undue stress fatigue in the pipe.

C. Handling
   1. Handle so as to insure installation in sound undamaged condition.
   2. Use equipment, tools and methods for unloading, reloading, hauling and laying that do not damage pipe or cause an impact. Damaged pipe will be cause for rejection
   3. Use hooks or straps with broad, well-padded contact surfaces for lifting sections of pipe

1.07 ENVIRONMENTAL REQUIREMENTS

A. Weather limitations: Do not install piping over frozen surfaces or in standing water.

PART 2 GENERAL PRODUCTS

2.01 PIPE AND FITTINGS MATERIALS [REMOVE PIPE MATERIALS THAT DO NOT APPLY]

A. Comply with [MUNICIPALITY] standards and specifications for public storm sewer products.

B. General: Provide pipes of one of the following materials, of weight/class indicated. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated

C. Fittings: Furnish bends, ells, tees, wyes, couplings and other fittings of the same type and class of material having equal or superior physical and chemical properties as acceptable to the Engineer

D. Reinforced Concrete Pipe: ASTM C76,
   1. 12-inch RCP Class V, with modified tongue-and-groove compression gasket joints complying with ASTM C443.
   2. 15-inch RCP Class IV (Class V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.
   3. 18-inch thru 24-inch RCP Class III (Class IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.

4. 24-inch thru 36-inch RCP Class II (Class III, IV or V when specified on plans), with modified tongue-and-groove compression gasket joints complying with ASTM C443.

E. PVC Sewer Pipe: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.

F. HDPE Sewer Pipe: smooth interior, corrugated exterior piping conforming to ASTM D 2412, ASTM D 3212, AASHTO specifications M252 and M 294, joints to conform to ASTM F 477.

G. Corrugated Metal Pipe (CMP): AASHTO M218 or ASTM A444, helically or circumferentially corrugated, mill galvanized steel.
   1. Furnish galvanized sheet metal, 16 gauge, 0.064-inch galvanized thickness, 0.0598-inch base metal thickness and size of conduit as indicated. Sizes indicated are minimal inside diameters. [12 OR 14 GAUGE MAY BE NEEDED FOR HIGH ABRASION USES]
   2. Furnish width and lap depths and corrugations conforming to AASHTO M36.

H. Perforated PVC Sewer Pipe: ASTM D3034, Type PSM, SDR 35 with PVC, elastomeric joints complying with ASTM D3212 using elastomeric seals complying with ASTM F477.

2.02 MATERIALS

A. Comply with Jefferson County standards and specifications for public storm sewer products.

B. Plugs and Caps: Use pipe plugs or caps provided by the pipe manufacturer and approved by the Engineer for pipe stubouts.

C. Cleanouts: Provide as indicated, pipe extension to grade with ferrule and countersink cleanout plug. Provide round cast-iron access frame over cleanout, with heavy duty secured scoriated cover with lifting device cast with the word “STORM”.

D. Reinforcement
   1. Reinforcing Steel: ASTM A615 Grade 60
   2. Welded Wire Fabric: ASTM A185

E. Concrete:
   1. Minimum compressive strength: ASTM C39, 4500 psi at 28 days
   2. Cement: ASTM C150, Portland Cement, Type II
   3. Aggregates: ASTM C33, free of deleterious substances

F. Gaskets:
   1. ASTM C990 for preformed flexible joint sealants
   2. FS SS-S-210A, "RAM-NEK" or accepted substitution
   3. Rubber: 40± 5 hardness when measured by ASTM D2240, Type A durometer

G. Inlet Gratings and Manhole Rings and Covers
   1. Cast iron, heavy duty traffic type, ASTM A48, Class 35B. Grind bearing surfaces to ensure flat, true surfaces
   2. Provide bike/pedestrian-safe grates where such traffic is anticipated
   3. Set grate on frame such that openings maximize inlet intake
   4. Covers to seat at all points on ring
   5. Covers to be cast with "STORM" in 2-inch tall flush letters
   6. Manhole covers to receive asphalt varnish coating hot dip applied at foundry, 6 mils thick

H. Manhole Height Adjustment: Use precast concrete grade rings

I. Rock Subbase: 1-1/2 inch minus, well-graded gravel over compacted subgrade

J. Water: Clean and free of deleterious substances

K. Grout:
   1. Non-Shrink, Non-Metallic Grout: Factory premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 4000 psi in one day and 8000 psi in 7 days
   2. Epoxy Grout: Three Component Epoxy Resin System

i) Two liquid epoxy components
ii) One inert aggregate filtered component
iii) Each component furnished in separate package for mixing at job site

2.03 CONCRETE CATCH BASINS AND MANHOLES

A. Comply withJefferson County standards and specifications for public storm sewer products.

B. Precast Concrete Units:
1. Manufacturers: Carder Concrete Products, Amcor Precast, or accepted equal
2. Specification: ASTM C478 and C789
3. Minimum wall thickness: greater of 6 inches or 1/12 of internal diameter
4. Reinforced
5. Grade rings as required
6. Cast steps into units.

C. Precast Units or Cast-in-place as shown. Use concrete that will attain a 28-day compressive strength of not less than 4500 psi with a cement content of not less than 6 sacks per cu. yd. Openings to be precast per plan or sawcut in field.

D. Cast-in-place Concrete Units: As shown on the drawings complying with the Jefferson County and Colorado Department of Transportation drainage and design standards.

2.04 PVC PLASTIC INLINE DRAINS AND DRAIN BASINS

A. Manufacturer: Nyloplast America Inc. or accepted substitution.

B. Inline drains and drain basins shall be manufactured from PVC pipe stock, utilizing a thermo molding process to reform the pipe stock to the furnished configuration. The drainage pipe connection stubs shall be manufactured from PVC pipe stock and formed to provide a watertight connection with the specified pipe system. The joint tightness shall conform to ASTM D3212.

C. Surface drainage products shall meet the mechanical property requirements for fabricated fittings as described in ASTM F794, F949 and F1336.

D. Inline drain and drain basin adapters and accessories
1. Adaptable to SDR-35 PVC piping.
2. Watertight adaptors.

E. Cast iron or ductile iron frames and grates:
1. Light –traffic rated
2. Pedestrian rated
3. Hinged and locking
4. Made specifically for use with the specified inline drains and drain basins
5. Painted black
6. ASTM A-48-83 Class 30B or A536 grade 70-50-05 grade iron
7. Size indicated on the drawings

2.05 CONCRETE FABRICATION

A. Comply with Jefferson County standards and specifications for public storm sewer products.

B. Vault/Manhole Sections
1. Precast concrete dimensions as shown on plans
2. Minimum manhole inside diameter: 48 inch
3. Precast lid and Cones: Same or greater reinforcement and wall thickness as vault or manhole section with capability for H20 loading
4. Vault Joints: Shiplap or tongue and groove with double mastic gaskets, each joint to set equally and tightly
5. Manhole Joints: Keylock type with double mastic gaskets, each joint to set equally and tightly
6. Access opening: Minimum 24 clear or as indicated
7. Pipe connection: As indicated on Drawings

8. Pipe knockout: As indicated on Drawings
9. Precast concrete, monolithic base or cast-in-place base
10. Manhole steps: 12 inch on center, vertical alignment above largest bench or open area

C. Grating and Metal Frame: As specified on drawings

2.06 SOIL MATERIALS

A. Comply with Jefferson County standards and specifications for public storm sewer products.

B. Furnish pipe bedding and cover as specified in Section 31 00 00 – Earthwork.

C. Riprap Materials:
1. Hard, dense, durable stone, angular in shape and resistant to weathering
2. Minimum specific gravity of 2.5
3. Material may be approved by Engineer, if by visual inspection, the rock is determined to be sound and durable
4. Engineer may require Contractor to furnish laboratory test results if the material appears to be marginal or unacceptable
5. Tested material shall meet the following requirements for abrasion resistance or compressive strength:

Test	Test Method	Requirement
Abrasion Resistance by Los Angeles Machine	ASTM C 535	50% loss, max
Unconfined Compressive Strength of Drilled Core Specimen	AASHTO T 24	2500, min

6. Contractor shall provide a five ton sample of riprap indicating the compliance to required material soundness and gradation specifications if requested by the Engineer.
7. Gradation:

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	Mean Particle Size, d_{50} (Inches)
Type L	70-100 50-70 35-50 2-10	15 12 9 3	9
Type M	70-100 50-70 35-50 2-10	21 18 12 4	12
Type H	70-100 50-70 35-50 2-10	30 24 18 18 6	18

8. Granular Riprap Bedding:
   a. 3/4” – 1” Crushed rock – AASHTO 57/67

Sieve Size (Inch)	Percent Passing by Weight
1	100
3/4”	90-100
1/2”	25-60
3/8”	20-55
NO. 4	0-10
NO. 8	0-5
NO. 200	0-2

D. Pipe Bedding:
   1. Refer to Section 31 00 00 – Earthwork
   2. Minimum 6 inch deep, unless specified otherwise

E. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
   1. Grab Tensile Strength: 110 lbf (490 N); ASTM D 4632.
   2. Tear Strength: 40 lbf (178 N); ASTM D 4533.
   3. Puncture Resistance: 50 lbf (222 N); ASTM D 4833.
   4. Water Flow Rate: 150 gpm per sq. ft. (100 L/s per sq. m); ASTM D 4491.
   5. Apparent Opening Size: No. 50 (0.3 mm); ASTM D 4751.

PART 3 EXECUTION

3.01 REGULATORY REQUIREMENTS

A. Comply with Jefferson County standards and specifications for public storm sewer installation.

3.02 PIPE PREPARATION

A. Shape trench and place bedding as specified in Section 31 00 00 and as shown on the drawings.
   1. Dig bell or coupling holes
   2. Do not support pipe on blocks or mounds of earth.
   3. Provide uniform and continuous bearing and support for full length of pipe between bell holes
   4. Minor disturbance over a maximum length of 18 inches near the middle of each length of pipe will be permissible by the withdrawal of pipe slings or other lifting tackle

B. Alignment and Grade
   1. Except as indicated on the Drawings, lay all pipe straight and at a uniform grade.
   2. Use batter boards to determine and check pipe subgrades.
   3. Other methods of maintaining alignment and grade may be acceptable if approved by the Engineer.

3.03 PIPE INSTALLATION

A. Inspect pipe and accessories for defects before lowering into trench.

B. Replace any defective, damaged or unsound pipe.

C. Carefully lower pipe, fittings, and accessories into the trench with derricks, ropes, and other suitable equipment to prevent damage. Do not dump or drop pipe or accessories into trench.

D. Pipe embedment shall be as specified in Section 31 00 00 for pipe.

E. Protect from lateral displacement by placing the specified pipe embedment material.

F. Do not lay pipe in water, under unsuitable weather conditions or under unsuitable trench conditions

G. Joint to form true and smooth line.

H. Remove any pipe not making a good fit.

I. Begin pipe laying at the lowest point unless reverse laying is accepted by Engineer.

J. Utilize implements, tools and facilities as recommended by the manufacturer and/or catch basins if required to remove debris.

K. Keep pipe clean during and after laying.

L. During construction, close all open ends with watertight expandable type plugs.
   1. At the end of each day's operations.
   2. Whenever pipe ends are left unattended.
   3. Deposit adequate backfill on pipe to prevent flotation.
   4. Do not use wood, burlap or other similar temporary plugs.

M. Remove and re-lay any pipe which has floated.

3.04 PIPE INSTALLATION – POLYPROPYLENE PIPE

A. Any pipe, fittings, or drainage structures with cuts, punctures, or other damage on the interior or exterior shall be rejected and replaced.

B. Any pipe, fittings or drainage structures with damaged ends or joints, which would prevent proper sealing of the joints, shall be rejected and replaced.

C. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm and drainage piping system. Location and arrangement of piping layout take design considerations into account. Install piping system as indicated herein and as directed by the product manufacturer, to extent practical. Where specific installation procedure is not indicated, follow product manufacturer's written instructions.

D. All products shall be inspected for defects and cracks before being lowered into the trench, piece by piece. Any defective, damaged or unsound pipe, fitting or drainage structure or any product that has had its grade disturbed after laying, shall be taken up and replaced. Open ends shall be protected with a pipe plug to prevent earth or other material from entering the pipe during construction. The interior of the pipe shall be free from dirt, excess water and other foreign materials as the pipe laying progresses and left clean at the completion of the installation.

E. Install piping system beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions. Follow product manufacturer's instructions for the use of lubricants, cements, and other special installation requirements.

F. Use Manholes or Catch Basins for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

G. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

H. Trench Excavation
   1. Excavate trenches to ensure that sides will be stable under all working conditions. Slope trench walls or provide supports in conformance with all local and national standards for safety. Open only as much trench as can be safely maintained by available equipment. Backfill all trenches as soon as practicable, but not later than the end of each working day.
   2. Where trench walls are stable or supported, provide a width sufficient, but no greater than necessary, to ensure working room to properly and safely place and compact haunching and other embedment materials. The space between the pipe and trench wall must be wider than the

compaction equipment used in the pipe zone. Minimum width shall be not less than the greater of either the pipe outside diameter plus 16 in. or the pipe outside diameter times 1.25, plus 12 in. In addition to safety considerations, trench width in unsupported, unstable soils will depend on the size and stiffness of the pipe, stiffness of the embedment and in-situ soil, and depth of cover.

3. When supports such as trench sheeting, trench jacks, trench shields or boxes are used, ensure that support of the pipe and its embedment is maintained throughout installation. Ensure that sheeting is sufficiently tight to prevent washing out of the trench wall from behind the sheeting. Provide tight support of trench walls below viaducts, existing utilities, or other obstructions that restrict driving of sheeting.

I. Bedding

1. A stable and uniform bedding shall be provided for the pipe and any protruding features of its joint and/or fittings. The middle of the bedding, equal to one-third of the pipe outside diameter, shall be loosely placed while the remainder shall be compacted to a minimum of 90% of maximum density per AASHTO T99, or as shown in the plans. Pipe bedding shall be a minimum of 4" – 6" in thickness. The bedding surface for the pipe shall provide a firm foundation of uniform density throughout the entire length of the pipe.

J. Placing Pipe

1. Each pipe shall be thoroughly examined before being laid; defective or damaged pipe shall not be used. Pipelines shall be laid to the grades and alignment indicated. Proper facilities shall be provided for lowering sections of pipe into trenches. Pipe shall not be laid in water, and the pipe shall not be laid when trench conditions or weather are unsuitable for such work. Diversion of drainage or dewatering of trenches shall be provided as directed by the engineer; see dewatering section.

K. Jointing

1. Joints shall be constructed as described herein and in accordance with manufacturer's installation instructions.
2. All Bell-and-Spigot pipe joints shall be thoroughly cleaned. Joint lubricant, supplied by the manufacturer, shall be liberally applied to entire interior of bell and gasket on spigot prior to assembly.

L. Backfilling

1. Backfill placement and compaction shall be constructed in accordance with the specifications herein and the product manufacturer's published installation guides.
2. After the pipe and pipe system have been properly bedded, selected material from excavation or borrow, at a moisture content that will facilitate compaction, shall be placed along both sides of pipe in layer depths to ensure minimum compaction density is obtained evenly throughout the backfill material. The backfill shall be brought up evenly on both sides of pipe and pipe system for the full length of pipe. The fill shall be thoroughly compacted under the haunches of the pipe. Each layer shall be thoroughly compacted with mechanical tampers or rammers. This method of filling and compacting shall continue until the fill has reached an elevation of at least 6 inches above the top of the pipe. The remainder of the trench shall be backfilled and compacted by spreading and rolling or compacted by mechanical rammers or tampers in layers not exceeding 8 inches. Tests for density shall be made as necessary to ensure conformance to the compaction requirements specified below. Where it is necessary, in the opinion of the Engineer, that sheeting or portions of bracing used be left in place, the contract will be adjusted accordingly. Untreated sheeting shall not be left in place beneath structures or pavements.
3. For pipe placed in fill sections, fill shall be constructed to at least 6 inches above the top of proposed pipe prior to trench excavation. Fill shall be placed in 12 inch lifts and shall be compacted to achieve 90% of maximum density, or as shown on plans. Once fill is placed and compacted pipe trench shall be constructed in accordance with the Trench Excavation section of this specification.

3.05 PRECAST STRUCTURE PREPARATION

A. Verify items provided by other section of Work are properly sized and located

B. Verify that built-in items are in proper location, ready for roughing into Work

C. Verify excavation for manholes is correct

D. Excavation and Backfill: Refer to Section 31 00 00 - Earthwork for requirements

E. Coordinate placement of inlet and outlet pipe or duct sleeves required by other sections

F. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction

3.06 CATCH BASINS

A. Construct catch basins to the sizes and shapes indicated, and to conform to requirements of authorities having jurisdiction.
   1. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction
   2. For precast units, set in place to accurate elevations on firm, solid bed, plumb and level.
   3. Pipe openings, elevations and alignment per plans
   4. Seal and grout all pipe penetrations
   5. Set cast iron frames and gratings to the elevations indicated.

3.07 PLACING MANHOLE SECTION OR CAST-IN PLACE BASE

A. Rock Subbase: Remove water, excavate, and place 1-1/2 inch washed rock 6-inch minimum depth, vibrate for compaction

B. Place base pad, trowel top surface level to accept manhole section with uniform bearing all around

C. Place sufficient non-shrink grout on base to ensure watertight fit between first manhole section and base or place first manhole section directly in wet concrete

D. Place manhole sections plumb and level, trim to correct elevations

E. Clean ends of sections and place double mastic gasket

F. Fill inside and outside of joint completely with non-shrink grout and trowel smooth

G. Cure non-shrink grout using approved methods

H. Set cover rings and covers level without tipping, to correct elevations or set cover rings and covers with slight tip to match cross slope of finished surface where directed by Engineer

I. Completed manholes shall be rigid and watertight

J. Coordinate with other sections of work to provide correct size, shape, and location

3.08 PREFORMED GASKETS

A. Remove and replace manhole sections which have chipped or cracked joints

B. Thoroughly clean section joints

C. Install gasket in conformance with manufacturer's recommendations

D. Only use primer furnished by gasket manufacturer

3.09 MANHOLE INVERT

A. Place concrete in bottom of manhole and form smooth transition. Trowel smooth and brush for non-skid finish. Slope bench 1 inch per foot for drainage to invert.

B. Invert shape to conform to radius of pipe it connects

C. Remove all rough sections or sharp edges which tend to obstruct flow or cause material to snag. Remove all grout droplets from invert

D. Construct in conformance with standard drawings

3.010 MANHOLE RINGS AND COVERS

A. Place rings in bed of non-shrink grout on top of manholes

B. Ensure no infiltration will enter manhole at this location

C. Carry non-shrink grout over flange of ring

D. Set top of ring flush with all surfaces subject to foot and vehicular traffic

E. Set top of ring 6 inches above surfaces in open, unraveled, non-pedestrian areas

F. Use precast grade rings for height adjustment

3.011 CONNECTION TO EXISTING MANHOLES

A. Maintain flow at all times

B. Prior approval of proposed method for maintaining flow must be obtained from Engineer

C. Cover area around new pipe with non-shrink grout and or waterstop gasket to ensure a watertight structure

D. Make connection during low flow periods

3.012 GROUT

A. PREPARATION
   1. Non-Shrink, Non-Metallic Grout, General Use
      a. Clean concrete surface to receive grout
      b. Saturate concrete with water for 24 hrs prior to grouting and remove excess water just prior to placing grout
      c. Cold weather conditions
         i) Warm concrete, substrate and base plate to 40 deg F, or above; store grout in warm area
         ii) Follow manufacturer's recommendations for cold weather application
      d. Hot weather conditions
         i) Use cold mixing water and cool base plate if possible; store grout in cool area
         ii) Follow manufacturer's recommendations for hot weather application
      e. Apply to clean, sound surface
      f. Apply latex bonding agent to hardened concrete, mix-in-grout, or as directed by Engineer
   2. Epoxy Grout: Apply only to clean, dry, sound surface
      a. Patching cavities in concrete including, but not limited to, tie holes, and structural and equipment support

B. APPLICATION
   1. Non-Shrink, Non-Metallic Grout
      a. Mix in a mechanical mixer
      b. Use no more water than necessary to produce flowable grout
      c. Provide air vents where necessary to eliminate air pockets
      d. Place in accordance with manufacturer's instructions
      e. Where exposed to view finish grout edges smooth
      f. Protect against rapid moisture loss by immediately covering with wet rags and polyethylene sheets or curing compound
      g. Wet cure grout for 7 days, minimum
      h. Maintain the temperature at a minimum of 40 deg F until grout reaches 3000 psi
      i. After placement of grout, eliminate excessive external vibration
   2. Epoxy Grout
      a. Mix and place in accordance with manufacturer's instructions
      b. Completely fill all cavities and spaces around dowels and anchors without voids
      c. Obtain manufacturer's technical assistance as required to insure proper placement

3.013 RIPRAP

A. Do not place riprap over frozen or spongy subgrade surfaces.

B. Place riprap at pipe outlets and in channels as indicated on plans. Top of riprap to match invert of outlet pie and channels.

C. Excavate and prepare subgrade.

D. Place geotextile fabric per plans under all bedding. Place bedding and place riprap on bedding per plans.

E. Material may be machine placed and then arranged as necessary by use of a Gradall with multi-prong grapple device or by hand to minimize voids. Dumping alone is not sufficient to achieve properly placed riprap.

3.014 FIELD QUALITY CONTROL

A. Field inspection and testing including a lamp test will be performed for every section of pipe after backfill has occurred
   1. Contractor shall furnish suitable assistance to the Engineer
   2. A minimum of 75% of a true circle will be required to indicate a properly constructed line
   3. Contractor will repair any section not passing the lamp test.

B. Request inspection immediately after placing cover over pipe.

C. Backfilling and testing as required per Section 31 00 00 - Earthwork.

END OF SECTION