ThreeRivers PARK DISTRICT in partnership with Scott County

CLEARY LAKE
MAINTENANCE BUILDING

At

Cleary Lake Regional Park
6246 190th St. E., Prior Lake, MN 55372

Issued July 25, 2019

PROJECT MANUAL

Book 1 of 2

SCOTT COUNTY
GOVERNMENT CENTER
200 4TH AVE W.
SHAKOPEE, MN 55379

CLE 1901

DOCUMENT 00 01 01 - TITLE PAGE

Three Rivers Park District in Partnership with Scott County

Cleary Lake Maintenance Building
Cleary Lake Regional Park
6246 190th St. E., Prior Lake, MN 55372

CLE 1901

OWNER:

Scott County
200 4th Ave. W
Shakopee, MN 55379

OWNER'S REPRESENTATIVE:

Name	:	Jason Zemke
Address	:	Three Rivers Park District 3000 Xenium Lane North Plymouth, MN 55441
Telephone	:	763-694-7601
Email	:	jason.zemke@threeriversparks.org

ARCHITECT:

Name	:	Oertel Architects, Ltd.
Address	:	1795 St. Clair Avenue Saint Paul, MN 55105
Telephone	:	(651) 696-5186
Fax	:	N/A
Contact	:	Ron Betcher, Jeff Oertel
Email	:	rbetcher@oertelarchitects.com, joertel@oertelarchitects.com

CIVIL ENGINEER:

Name	:	SRF Consulting Group, Inc.
Address	:	One Carlson Parkway North, Suite 150 Minneapolis, MN 55447
Telephone	:	(763) 475-0010
Fax	:	1 (866) 440-6364
Contact	:	Michael Aaron
Email	:	maaron@srfconsulting.com

ELECTRICAL ENGINEER:

Name	:	Paulson & Clark Engineering
Address	:	2352 East County Road J White Bear Lake, MN 55110
Telephone	:	(651) 287-7501
Fax	:	N/A
Contact	:	Dan Paulson
Email	:	dpaulson@paulsonclark.com

MECHANICAL ENGINEER:

Name	: Paulson & Clark Engineering
Address	: 2352 East County Road J White Bear Lake, MN 55110
Telephone	: (651) 287-7509
Fax	: N/A
Contact	: Travis Willemssen
Email	: twillemssen@paulsonclark.com

STRUCTURAL ENGINEER:

Name	: Meyer Borgman Johnson
Address	: 510 Marquette Avenue South, Suite 900 Minneapolis, MN 55402
Telephone	: (612) 604-3625
Fax	: (612) 337-5325
Contact	: Bob Chilson
Email	: bchilson@mbjeng.com

INVESTIGATION REPORTS:

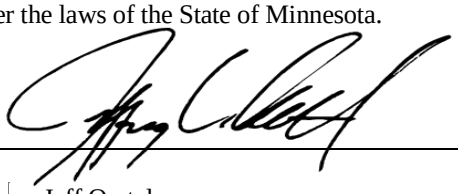
Name	: American Engineering Testing
Address	: 550 Cleveland Avenue North St. Paul, MN 55114
Telephone	: (651) 999-1387
Fax	: N/A
Contact	: Bruce Boehm Carlson

GEOTECHNICAL ENGINEER:

Name	: American Engineering Testing
Address	: 550 Cleveland Avenue North St. Paul, MN 55114
Telephone	: (651) 789-4674
Fax	: N/A
Contact	: Katherine Zadrozny

DOCUMENT 00 0105 - CERTIFICATION

I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Architect under the laws of the State of Minnesota.

Signature: 

Printed Name: Jeff Oertel License No. 15840

Date: 07/25/2019

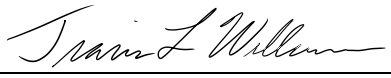
I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: 

Printed Name: Michael Aaron License No. 25721

Date: 07/25/2019

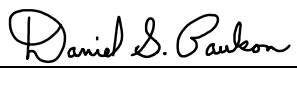
I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: 

Printed Name: Travis Willemsen License No. 47945

Date: 07/25/2019

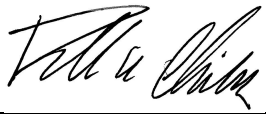
I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: 

Printed Name: Dan Paulson License No. 23796

Date: 07/25/2019

I hereby certify that this specification was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Signature: 

Printed Name: Bob Chilson License No. 40856

Date: 07/24/2019

END OF SECTION 00 01 05

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NOT USED

DOCUMENT 00 11 13

ADVERTISEMENT FOR BIDS

(OFFICIAL PUBLICATION)
Advertisement for Bids

Scott County
Shakopee, MN

Project Name: Cleary Lake Regional Park Maintenance Building
Project Location: 6246 190th St. E., Prior Lake, MN 55372

Sealed bids will be received in the Scott County Public Works Conference Room, 600 Country Trail East, Jordan, MN 55352 and opened at 2:00 PM, on August 15, 2019, for furnishing all labor, materials, equipment, and skill required for work as described in the Bidding Documents. The project in general includes, but is not limited to, demolition of an existing building and construction of a new 7,680 square foot maintenance building (with mezzanine) made of wood construction. Included in the scope are concrete floors, new finishes, doors, windows, mechanical / electrical systems, and related building components.

Contractors are encouraged to visit the site on their own.

Proposal forms and other contract documents are on file and may be examined in the Scott County Government Center, 200 4th Avenue West, Shakopee, MN 55379. Contact Dustin Kruger, (952) 496-8967.

A complete digital copy of the specifications and drawings are available at www.questcdn.com. Documents may be downloaded for a non-refundable fee of $25.00 by inputting Quest project #6429130 on the web site's Project Search page. Please contact QuestCDN at (952) 233-1632 or info@questcdn.com for assistance in registration and downloading the digital project information. An optional paper set of specifications and drawings may be obtained from QuestCDN's printing partner, Document Corporation, Phone (763) 475-9600.

The current minimum wage rate per hour to be paid for each classification of work shall be the local prevailing rate, including fringe benefits as defined in Minnesota Statute 177.41-177.44.

No bid will be considered unless sealed and filed with the County before the stated bid time and accompanied by a Bidder's Bond or Certified Check made payable without recourse to Scott County in an amount equal to five percent (5%) of the total base bid. A Performance Bond and a Labor and Material Payment Bond, each in the full amount of the Contract Sum, will be required of the successful bidder.

No bid may be withdrawn for a period of sixty (60) calendar days after bids are opened. The Owner reserves the right to reject any or all bids and to waive irregularities and formalities at the complete discretion of the County.

Advertisement of bids is pursuant to Minnesota Statutes Sections 375.21, 471.345, and 471.35 and all other applicable law.

(Published in the Belle Plaine Herald, Wednesdays, July 24, 31 and August 7, 2019)

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DOCUMENT 00 21 13

INSTRUCTIONS TO BIDDERS

1. FORM OF BID:

All bids must be submitted on the unaltered forms provided. Each bid must be submitted in a sealed envelope clearly marked:

Scott County Public Works
600 Country Trail East
Jordan, MN 55352
"Bid for Cleary Lake Regional Park Maintenance Building"

and must be accompanied by the required Bid Security, Responsible Contractor Verification and Certification Compliance forms.

2. BIDDING REQUIREMENTS:

A. Bids will be accepted only on the basis of performing all of the work outlined in the Bid.

B. Bidders must submit a bid amount for all bid items listed in the Bid Form, including all alternates, if any. Bids must be submitted by properly filling each and every space provided for that purpose on the Bid hereto attached. Bids not conforming to these requirements may be rejected as irregular.

C. No bid may be withdrawn for a period of sixty (60) calendar days from the opening thereof. All bids shall be held firm until the award has been made. Deviations from this requirement may be cause for rejection.

D. Collusion between bidders is cause for rejection of all bids by bidders involved in any way in the collusion.

E. A bid containing an alteration or erasure of any price contained in the bid which is used in determining the lowest responsive bid shall be rejected unless the alteration or erasure is corrected as herein provided. An alteration or erasure may be crossed out and the correction thereof printed in ink or typewritten adjacent thereto and initialed in ink by the person signing the bid.

F. The Owner cannot award a construction contract in excess of $50,000 unless the bidder is a "Responsible Contractor" as defined in Minnesota Statute § 16c.285, subdivision 3. A bidder submitting a proposal for this project must verify that it meets the minimum criteria specified in that statute.

G. Each bidder, by signing and submitting a Bid Form, represents that his bid is based upon the materials and equipment described or designated by manufacturer's name, catalog number or trade name in the contract documents and that, if awarded the contract, he will furnish or use only materials and equipment so described or designated. No substitution will be considered unless written request has been submitted to the Architect for approval at least seven (7) calendar days prior to the date and hour set for receipt of bids. Each such request shall include a complete description of the proposed substitution, the name of the material or equipment for which it is to be substituted: drawings, cuts, performance and test data and any other data or information necessary for a complete evaluation by the Architect. If the Architect approves any proposed substitution, such approval will be set forth in an Addendum.

3. INFORMATION CONCERNING THE WORK AND THE SITE:

A. Each bidder shall carefully examine the drawings and specifications and be fully informed as to the nature, location, and conditions under which the work is to be performed or materials delivered. Bidders shall not rely upon statements or representations of officers or employees of the Owner with reference to the site or the conditions of the work.

B. The bidder is invited to visit and inspect the site with the Owner's representative prior to the bid opening.

4. ADDENDA:

Any addenda issued during the time of bidding shall be covered in the bid and, in closing a Contract, they will become a part thereof. List on the Bid Form all addenda received. Failure of a bidder to receive any addendum shall not release the bidder from any obligations covered by the contract documents, provided said addendum was transmitted to the number or address furnished by the bidder for transmittal of facsimile (fax), mail, or electronic mail (E-mail). It shall be the bidder's responsibility to make inquiry as to addenda issued. Failure of a bidder to list all addenda on the Bid Form may subject a bidder to disqualification.

5. BID SECURITY:

A. Each bidder must submit bid security in the form of cash, certified check or bid bond payable to the Owner in an amount not less than five percent (5%) of the total base bid submitted.

B. The bid security shall be forfeited if the bidder fails or refuses to enter into Contract and furnish appropriate Bonds and Insurance within fifteen (15) calendar days after bidder's bid is accepted. This clause in no way shall limit the Owner's remedies in law or in equity.

C. Bid security, if other than the form of a Bid Bond, will be returned within twenty (20) calendar days after acceptance of Contract by the Owner. Bid security in the form of a Bid Bond will not be returned unless the bidder submits a written request to the Owner prior to acceptance of the contract by the Owner.

6. AWARD OF BID, EXECUTION OF CONTRACT:

A. Scott County Board of Commissioners intends to meet on August 20 to consider the bids. Acceptance of a bid shall bind the bidder to provide bonds and certificates and to execute an agreement, the form of which is included in these specifications, within fifteen (15) calendar days after notification of such award.

B. The Owner reserves the right to accept or reject any or all bids or any part of any Bid as the Owner, in its sole discretion, determines to be in its best interests. The Owner specifically reserves the right to reject any or all Bids or any part of any Bids for minor deviations from format or clerical omissions.

C. The award of contract, if it be awarded, will be made within sixty (60) calendar days after the opening of proposals.

D. All contracts and purchases made by or under the supervision of the Owner for which competitive bids are required shall be awarded to the responsible bidder submitting the lowest responsive bid, taking into consideration conformity with the specifications, terms of delivery and other conditions imposed in the call for bids.

E. The Owner will only consider bids from responsible bidders. The Owner shall have the right to determine bidder's responsibility in accordance with bidder qualification forms/process as per the contract documents for all purchases.

F. The Owner shall have the right to accept Alternates, if any, in any order or combination, unless otherwise specifically provided in the bidding documents, and to determine the lowest bid on the basis of the sum of the total base bid amount and Alternates accepted.

7. PERFORMANCE BOND AND LABOR AND MATERIALS PAYMENT BOND:

A Performance Bond and a Labor and Material Payment Bond, each in the full amount of the contract sum, will be required of the successful bidder.

8. LABOR AND WAGE RATE REQUIREMENTS:

Pursuant to Minnesota Statutes 177.41 to 177.44 and corresponding Rules 5200.1000 to 5200.1120, this contract is subject to the prevailing wages as established by the Minnesota Department of Labor and Industry. Specifically, all contractors and subcontractors must pay all laborers and mechanics the established prevailing wages for work performed under the contract. Failure to comply with the aforementioned may result in civil or criminal penalties.

9. PAYMENT:

A. Payment to the Contractor may be made not more frequently than monthly in accordance with the General Conditions of Contract.

10. PRE-CONSTRUCTION MEETING:

Subsequent to the award of the Contract for work or notice to proceed, a pre-construction meeting will be held at the project site. The purpose of the meeting shall be to review all items which will affect the proper execution and expediting of the work. The meetings shall be attended by qualified spokesmen representing the Contractor and the Owner.

END OF DOCUMENT 00 21 13

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DOCUMENT 00 31 32

GEOTECHNICAL DATA

1. Geotechnical data provided by Owner is not warranted by Owner for accuracy and shall be used by Contractor at Contractor's sole risk. Refer to technical data, which follows this Document.

END OF DOCUMENT 00 31 32

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AMERICAN ENGINEERING TESTING, INC.

REPORT OF GEOTECHNICAL EXPLORATION

Cleary Maintenance Shop

6246 190th Street East
Prior Lake, Minnesota

AET No. 01-20471

Date:
June 27, 2019

Prepared for:
Scott County
c/o Three Rivers Park District
3000 Xenium Lane North
Plymouth, Minnesota 55441

AMERICAN ENGINEERING TESTING, INC.

June 27, 2019

Scott County
c/o Three Rivers Park District
3000 Xenium Lane North
Plymouth, Minnesota 55441

Attn: Jason P. Zemke, AIA

RE: Geotechnical Exploration
Cleary Maintenance Shop
6246 190th Street East
Prior Lake, Minnesota
AET No. 01-20471

Dear Mr. Zemke:

American Engineering Testing, Inc., (AET) is pleased to present the results of our subsurface exploration program and geotechnical engineering review for the Cleary Maintenance Shop project in Prior Lake, Minnesota.

We are submitting an electronic copy of the report to you. If there are additional submissions that you would like, please let us know.

Please contact me if you have any questions about the report. I can also be contacted for arranging construction observation and testing services.

Sincerely,
American Engineering Testing, Inc.

Katherine E. Zadrozny, PE
Geotechnical Engineer
651-789-4674
kzadrozny@amengtest.com

SIGNATURE PAGE

Prepared for:

Scott County
c/o Three Rivers Park District
3000 Xenium Lane North
Plymouth, Minnesota 55441
Attn: Jason Zemke, AIA

Prepared by:

American Engineering Testing, Inc.
550 Cleveland Avenue North
St. Paul, Minnesota 55114
(651) 659-9001 / www.amengtest.com

Authored by:

Katherine E. Zadrozny, PE
Geotechnical Engineer

Reviewed by:

William K. Cody, PE
Principal Engineer

I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under Minnesota Statute Section 326.02 to 326.15.

Name: Katherine E. Zadrozny

Date: 6-27-2019 **License #:** 54248

TABLE OF CONTENTS

1.0 INTRODUCTION

You are proposing to construct a single-story maintenance shop with mezzanine and adjacent pavements, in Prior Lake, Minnesota, at the site of an existing residential structure. To assist with planning and design, you have authorized American Engineering Testing, Inc., (AET) to conduct a subsurface exploration program at the site, conduct soil laboratory testing, and perform a geotechnical engineering review for the project. This report presents the results of the above services, and provides our engineering recommendations based on this data.

2.0 SCOPE OF SERVICES

AET's services were performed according to our proposal to you dated May 3, 2019, which you authorized May 6, 2019. The authorized scope consists of the following:

- Seven standard penetration test (SPT) borings to a depth of 21 feet each.
- Soil laboratory testing.
- Geotechnical engineering review based on the obtained data and preparation of this report.

These services are intended for geotechnical purposes only. The scope is not intended to explore for the presence or extent of environmental contamination in the soil or groundwater.

3.0 PROJECT INFORMATION

The project site is located at 6246 190th Street East. A site plan prepared by Oertel Architects, Ltd. was provided to us showing the layout of the existing structure and the outline of the proposed structure. The new building will have approximate plan dimensions of 110 feet by 60 feet. The new building is planned to be built in the northwest portion of the site with new parking located to the west of the new building, and between the building and 190th Street East. Surrounding pavements are also planned for maintenance needs.

The building will be a wood stud and wood truss structure with steel columns and beams. We also understand the building will have cast-in-place concrete foundations and slab-on-grade construction in the office areas. The building is planned to include four drive-in bays with heated interior concrete slabs. The finished floor elevation (FFE) is about 961 feet, according to Oertel Architects. We understand that maximum column loads will be 60 kips, and assume maximum wall loads will be 5 to 7 kips per lineal foot, and floor slab live loads would be 150 psf or less.

Parking and drive areas are assumed to be used primarily by automobiles and light trucks/vans with axle loads less than 4 tons.

Our foundation design assumptions include a minimum factor of safety of three with respect to the ultimate bearing capacity. We understand the structure will be able to tolerate total settlements up to 1 inch, and differential settlements over a 30-foot distance up to ½ inch.

The above stated information represents our understanding of the proposed construction. This information is an integral part of our engineering review. It is important that you contact us if there are changes from that described so that we can evaluate whether modifications to our recommendations are appropriate.

4.0 SUBSURFACE EXPLORATION AND TESTING

4.1 Field Exploration Program

As requested, the subsurface exploration program conducted for the project consisted of seven standard penetration test borings at specified locations. The number of borings, boring locations, and boring depths were provided by Three Rivers Park District. The logs of the borings and details of the methods used appear in Appendix A. The logs contain information concerning soil layering, soil classification, geologic description, and moisture condition. Relative density or consistency is also noted for the natural soils, which is based on the standard penetration resistance (N-value).

The borings were located in the field by a representative of Three Rivers Park District. Approximate boring locations are shown on Figure 1 in Appendix A. Boring coordinates and elevations were provided by Three Rivers Park District.

4.2 Laboratory Testing

The laboratory test program included water content tests on cohesive samples. The test results appear in Appendix A on the individual boring logs adjacent to the samples upon which they were performed.

5.0 SITE CONDITIONS

5.1 Surface Observations

As previously stated, the project site is currently developed. The area of the proposed building is occupied by an existing residential structure with scattered trees and bushes, as well as a perimeter fence. A sidewalk also runs south from the building to a gravel parking area.

The proposed building area is relatively flat with about 2 feet of grade change in the building footprint. Outside of the building footprint, the northern and eastern portions of the site slope gently down from the existing building.

5.2 Subsurface Soil Conditions and Properties

The observed soils at the boring locations consist of about 2 to 9½ feet of fill over till and alluvial soils. Refer to the following text and our boring logs for a full description and depth information.

5.2.1 Fill

The project borings were performed in lawn areas around the existing building. The upper 2 to 9½ feet was observed to be fill soils consisting of sandy lean clay, clayey sand, silty sand, and sand with silt. The composition of the fill soils tended to become more granular with depth. The deepest fill soils were observed at Boring B-2.

The N-values recorded in the fill ranged from 5 blows per foot (bpf) to 8 bpf. We have no documentation of how the fill soils were placed on this site. Based on observation of the recovered soil samples and respective N-values, we judge the fill to have relatively low strength and moderate compressibility. The granular fill soils are judged to be relatively fast draining while the more cohesive soils are judged to be relatively slow draining. The fill soils are judged to be at least moderately susceptible to freeze-thaw movements.

There were also possible fill soils (noted as "Till or Fill" or "Coarse Alluvium or Fill") observed to depths of about 4½ feet to 9½ feet at Borings B-1, B-3, B-4, B-5, and B-6. We could not identify the geologic origin of these soils from the limited samples. Any documents relating to previous site development should be provided for our review.

5.2.2 Till

Sandy lean clay and clayey sand soils are present below the fill and interbedded with the coarse alluvium. We judge the till to have moderate strength and moderate compressibility. The till soils are slow draining and will be susceptible to freeze-thaw movements if they are exposed to freezing temperatures.

5.2.3 Coarse Alluvium

Coarse alluvium was observed from the bottom of fill or till to the boring termination depths of 21 feet. Coarse alluvium was also observed below the fill and above the till in some instances. The

coarse alluvium consists of fine to coarse grained sands with varying amounts of silt and gravel. The coarse alluvial soils had blow counts of 9 bpf to 37 bpf.

These coarse alluvial soils are judged to have moderately high strength and moderately low to low compressibility. The coarse alluvial soils are judged to be relatively fast-draining and not significantly frost-susceptible.

5.3 Groundwater

Groundwater levels fluctuate due to varying seasonal and annual rainfall and snow melt amounts, as well as other factors. Water levels were observed as indicated below.

Table 5.3 – Groundwater Observations

Boring Location	Surface Elevation (ft)	Groundwater Observation (ft, below existing grade)	Groundwater Elevation (ft)
B-1, B-2, B-3, B-4	960.3 to 961.9	Not observed	Below boring termination depth
B-5	961.6	15.1 when drilled and 14.7 at 3 days (when the boring was finished)	946
B-6	961.0	Not observed	Below boring termination depth
B-7	958.9	8 during drilling, 7.9 at ten minutes, and 19.1 at thirty minutes	940

We judge that Boring B-7 encountered perched conditions above the observed till. Groundwater elevations can be more accurately estimated with piezometers, which were not performed as part of this scope.

6.0 RECOMMENDATIONS

6.1 Approach Discussion

The naturally deposited soils encountered at the boring locations appear to be generally suitable to support the proposed structure on spread footing foundations, provided corrective earthwork is performed as recommended below. Most on-site soils appear to be suitable for re-use as structural fill provided they don't contain any organics, rubble, or other deleterious materials. New fill placed

above the native alluvium can provide support for new foundations and floor slabs.

Existing fill soils were encountered to about 2 to 9½ feet below existing grade. It is our opinion that these existing fill soils were not placed with moisture and density control, and should not be relied upon for support of the new building. Relying on the existing fill soils for structural support may result in foundation and slab settlements that are greater than normally tolerable amounts. Excavations for the structure should extend through existing fill to develop more reliable and suitable support from the native alluvial soils. Additionally, a geotechnical engineer should observe the possible fill soils to see whether they are suitable for structural support. Excavations may encounter rubble related to the existing development or cobbles and boulders in native soils.

Based on the observed perched water conditions at Boring B-7, water may be encountered when excavating. A simple sump pump should be able to remove any perched water.

6.2 Building Grading

6.2.1 Excavation

To prepare the building area for foundation and slab support, we recommend complete excavation of the surface materials, fill, existing footings and/or slabs, and any other deleterious materials. Any underground utilities that are present below the building should be removed and re-routed around the new building. This excavation should expose the native alluvial soils, pending assessment of the possible fill soils.

Based on the depth of fill and observations of trace roots within soils, we recommend the following minimum excavation depths, provided in Table 6.2.1. Excavations may need to extend deeper to meet the recommended foundation depths as discussed in the following sections.

Table 6.2.1 – Recommended Minimum Excavation Depths

Boring Location	Surface Elevation (ft)	Excavation Depth (ft, below existing grade)	Approximate Minimum Excavation Elevation (ft)
B-1	961.4	2-4½	959½
B-2	961.8	9½	952½
B-3	961.9	4½	957½
B-4	960.3	4½-9½	959
B-5	961.6	2-4½	959½
B-6	961.0	4½-9½	956½

The estimated excavation depths in Table 6.2.1 are based on the soil conditions at the specific boring locations. Because conditions will vary away from the boring locations, we recommend that AET geotechnical personnel observe and confirm the competency of the soils in the excavation bottom prior to new fill or footing placement.

If existing fill soils are at bearing depth, excavations should extend through the fill to competent native soils. Where the excavation extends below foundation grade, the excavation bottom and resultant engineered fill system must be oversized laterally beyond the planned outside edges of the foundations to properly support the loads exerted by that foundation. This excavation/engineered fill lateral extension should at least be equal to the vertical depth of fill needed to attain foundation grade at that location (i.e., 1:1 lateral oversize).

6.2.2 Fill Placement and Compaction

Fill placed in the building pad should be compacted in thin lifts, such that the entire lift achieves a minimum compaction level of 95% of the standard maximum dry unit weight per ASTM: D698 (Standard Proctor test).

Based on the soils observed in our soil borings, it appears that some of the on-site inorganic soils can be re-used as structural fill, although these soils should be carefully selected. On-site soils should be placed and compacted at moisture contents within +/-2% of the respective optimum moisture contents. Additional fill required to establish final site grades should consist of imported granular soils with less than 12% passing the No. 200 sieve (meeting MnDOT 3149.2.B.2 Specification). All fill should be free of debris, rubble, organics, and other unsuitable materials. Fill soils should not contain pieces larger than 3 inches in diameter. All fill soils should be compacted with equipment which will densify the entire lift of fill. Fill should not be placed over frozen soils and frozen soils should not be used as fill.

6.3 Foundation Design

The building can be supported on conventional spread footing foundations placed on native alluvial or till soils or new compacted fill over native alluvial soils. We recommend perimeter foundations for heated building spaces extend to a minimum of 42 inches below exterior grade. We recommend foundations for unheated building space (such as canopy foundations) extend to a minimum of 60 inches below exterior grade. Interior footings in heated building spaces can be placed at a convenient depth below the slab.

Prior to footing construction, the exposed bearing surfaces should be surface compacted with manually-operated vibratory equipment. Based on the conditions encountered, it is our opinion the building foundations can be designed based on a net maximum allowable soil bearing pressure of 3,000 psf. It is our judgment this design pressure will have a factor of safety of at least 3 with respect to the ultimate bearing capacity. We estimate that total settlements under this loading should not exceed 1 inch and differential settlements should not exceed ½ inch.

We recommend that continuous wall footings have a minimum width of 18 inches and that individual column footings be at least 3 feet wide to avoid excessively narrow footings. These minimum widths should be used even if the resulting contact pressure is less than our recommended maximum value.

The bottoms of all foundation excavations should be free of water and loose soil prior to placing structural fill or concrete. Structural fill should be placed soon after excavating to reduce bearing soil disturbance, and concrete should be placed soon after excavating or completion of the structural fill placement. If the materials at bearing level become excessively dry, disturbed or saturated, or frozen, the affected material should be removed and replaced prior to placing concrete.

6.4 Floor Slab Subgrade

For relative ease of compaction in confined spaces, we recommend using only granular soils with less than 12% passing the No. 200 sieve as interior backfill adjacent to the new foundations and in underslab utility trenches inside the building. We also recommend the upper 6 inches of soil below the slab consist of sand or sand with silt (SP or SP-SM) or crushed aggregate base. The aggregate base should satisfy MnDOT Spec. 3138 (Class 5) requirements.

Based on a subgrade prepared with sand backfill, the floor slabs can be cast on-grade. For slabs cast on new compacted sand or sand with silt fill, we recommend using a modulus of subgrade reaction (k) of 200 pounds per square inch per inch of deflection (pci) for design of the slabs. A vapor retarder should be placed under the floor slab where there are moisture sensitive floor coverings/coatings. Refer to our appended standard sheet “Floor Slab Moisture Vapor Protection” for more details.

6.5 Exterior Underground Utilities

The excavated non-organic soils, or the till or coarse alluvial soils can be used to support the

underground utilities and as backfill over the new utility lines. This backfill should be placed in lifts not exceeding 6 inches thick, with each lift compacted to at least 95% of the maximum Standard Proctor dry density. Where utility lines lie under or pass under pavements, we recommend that the upper 3 feet of backfill be compacted to at least 100%. Under lawn areas, the degree of compaction should be at least 90%.

6.6 Exterior Entry Slabs

Where exterior entry slabs or sidewalks abut the building, we recommend constructing a subgrade of non-frost susceptible (NFS) sands rather than using on-site silty or clayey soils. The purpose of this is to reduce the potential for the characteristic heave that occurs when silty soils freeze in the winter. This heave can raise the slabs causing jamming of doorways and possible damage to the building, and can create trip hazards. Alternatively, the entry slabs can be designed as structural slabs supported by spread footings placed at least 60 inches below grade. The slab should be designed with a 3-inch air gap below the slab to reduce the effects of frost heave on the slab.

The NFS sand should be select granular soil with less than 5% passing the No. 200 sieve and less than 50% passing the No. 40 sieve. It should be placed at least 4 feet thick under the slab and at least 2 feet beyond the outside edges of the slab to minimize abrupt differential movement. This fill should be compacted to at least 95% of the maximum Standard Proctor dry density.

6.7 Pavements

6.7.1 Subgrade Preparation

To prepare the pavement subgrades, we recommend removing surficial vegetation and organic soils to expose underlying inorganic soils. Any underlying soft or disturbed soils noted during the initial site stripping may also need to be removed and should be evaluated by AET geotechnical personnel. The subgrades should be test rolled to evaluate stability and strength prior to placing fill or paving.

Following site stripping and excavation, fill can be placed as needed to re-attain subgrade elevation. We recommend that fill soils should consist of granular soils (SP, SP-SM, SM) or sandy lean clays (CL) or clayey sands (SC) and in no case should they consist of organic soils (OL/OH). Frozen soils should not be used as fill and new fill soils should not be placed over frozen subgrades.

All fill should be placed and compacted per the requirements of MnDOT Specification 2105.3.F.1 (Specified Density Method). This specification requires soils placed within the upper 3 feet of the

subgrade be compacted to a minimum of 100% of the Standard Proctor maximum dry weight (as defined in ASTM: D698) at water contents of 65% to 102% of their respective optimum water contents. A reduced minimum compaction level of 95% can be used below the upper 3 feet of the subgrade zone.

6.7.2 Subgrade Stability and Test Roll

Subgrade stability within the upper 3 feet of the pavement subgrade is important for pavement support, construction, and performance. Stability of the subgrade soils should be evaluated using the test roll procedure before placement of the new aggregate base layer. The test roll procedure should be conducted by having a loaded, tandem-axle dump truck make repeated passes over the subgrade soils. The test roll will help to delineate any unstable soils that will not be acceptable as pavement subgrade soils. These unstable soils should be removed and replaced; or aerated, dried and recompacted back into place as recommended by AET geotechnical personnel. Another test roll should be performed after the corrective earthwork is completed to aid in evaluating subgrade stability.

6.7.3 Sand Subbase and Drainage

Long term pavement performance is dependent on having good frost/drainage control and a high degree of soil stability in the upper 3 feet of the subgrade. The use of a consistent thickness sand subbase layer will improve the pavement performance and drainage, will reduce periods of saturation and thaw weakening, and will better control frost movements, thereby improving long-term pavement performance. It will also provide a more uniform subgrade. Because of these benefits, we recommend strongly considering the use of the sand subbase.

If a sand subbase layer is placed, we recommend that it be at least 12 inches thick below light duty pavements. We recommend increasing the sand subbase layer thickness to 18 inches in heavy duty pavement areas. We understand that this sand layer will come at a higher initial cost; however, this cost will at least be partially outweighed by the savings from reduced long-term maintenance costs and slightly thinner pavement sections. The sand subbase layer should consist of Select Granular Material which meets the requirements of MnDOT Spec. 3149.2.B.2.

Assuming the sand subbase will be placed over slower-draining silty and clayey soils, subsurface drainage should be provided to prevent buildup of water in the sand subbase layer. This can be done by connecting finger drains to manholes and catch basins at depths just below the bottom of the sand layer. In other areas where there are long distances between structures, drain lines can be

installed at the bottom of the sand layer. The drain tiles should be surrounded by filter or drainage gravel that is enveloped by geotextile fabric, and then covered by the sand. The slow draining soils at the bottom of the subcut excavation should be shaped to slope in the direction of the drain tiles and promote subsurface flow of water to the drain tiles for collection and removal. The drain lines should be provided with an avenue of discharge (storm sewer or gravity flow to a low site area) to dispose of the collected water.

For transitioning the thickness of the sand subbase between light and heavy duty pavement zones, we recommend tapering the sand subbase thickness at a 6H:1V or flatter slope to reduce the potential for abrupt frost heave zones. The subcut and sand subbase placement should extend about 1 foot beyond the outer edge of curbs to maintain frost uniformity.

6.7.4 Estimated R-value

After completion of the subgrade preparation as presented above, and assuming the soils in the upper 3 feet of the subgrade will consist of compacted sandy lean clays (the limiting soil type), we estimate a subgrade R-value of 15 can be used for pavement design. If a sand subbase layer at least 12 inches thick is placed above the sandy lean clay or clayey sand subgrade, we recommend using an R-value of 25 for design of the pavements.

6.7.5 Section Thicknesses

We are presenting pavement designs based on two potential traffic situations (light and heavy duty). The light duty design refers to parking areas which are intended only for automobiles and passenger truck/vans. The heavy duty design is intended for drive lane and pavements which will experience the heavier bus and truck traffic (9-ton to 10-ton design load). We understand the heaviest equipment will be on the order of 8½ tons per axle. The recommended pavement thicknesses are shown in Tables 6.7.5a and b below:

Table 6.7.5a – Pavement Thickness Designs (No Sand Subbase)

Material	**Section Thickness with Sandy Lean Clay Subgrade**	
	Light Duty	**Heavy Duty**
Bituminous Wear	2 inches	2 inches
Bituminous Non-Wear	2 inches	3 inches
Class 5 Aggregate Base	6 inches	9 inches
Sand Subbase	--	--
Total Thickness	**10 inches**	**14 inches**

Table 6.7.5b – Pavement Thickness Designs (With Sand Subbase)

Material	Section Thickness with Sandy Lean Clay Subgrade	
	Light Duty	**Heavy Duty**
Bituminous Wear	2 inches	2 inches
Bituminous Non-Wear	1½ inches	2 inches
Class 5 Aggregate Base	6 inches	6 inches
Sand Subbase	12 inches	18 inches
Total Thickness	**21½ inches**	**28 inches**

6.7.6 Pavement Maintenance

Even if placed and compacted properly on stable subgrade conditions, bituminous pavements will still experience cracking in 1 to 3 years, primarily due to temperature-related expansion and shrinkage. We recommend that a regularly scheduled maintenance program consisting of patching of cracks and local distressed areas be implemented. Seal coating of the pavement surface after 3 to 5 years often helps prolong the pavement life.

7.0 CONSTRUCTION CONSIDERATIONS

7.1 Potential Difficulties

7.1.1 Disturbance of Soils

The on-site soils can be disturbed by construction traffic, especially if the soils are wet. If soils become disturbed, they should be subcut to the underlying undisturbed soils. The subcut soils can then be dried and recompacted back into place, or they should be removed and replaced with drier imported fill.

7.1.2 Runoff Water in Excavation

Water can be expected to collect in the excavation bottoms during times of inclement weather or snow melt. To allow observation of the excavation bottoms, to reduce the potential for soil disturbance, and to facilitate filling operations, we recommend water be removed from within the excavation during construction. Based on the soils encountered, we anticipate the groundwater can be handled with conventional sump pumping.

7.1.3 Cobbles, Boulders, Rubble, and Debris

The native soils at this site can include cobbles and boulders. The fill soils may also include cobble- and boulder-sized rubble and debris. Larger pieces of concrete or slabs may also exist. This may

make excavating procedures somewhat more difficult than normal if they are encountered.

7.2 Excavation Backsloping

If excavation faces are not retained, the excavations should maintain maximum allowable slopes in accordance with *OSHA Regulations (Standards 29 CFR), Part 1926, Subpart P, "Excavations"* (can be found on www.osha.gov). Even with the required OSHA sloping, water seepage or surface runoff can potentially induce slope erosion or sloughing which could require slope maintenance.

7.3 Observation and Testing

The recommendations in this report are based on the subsurface conditions found at our test boring locations. Since the soil conditions can be expected to vary away from the soil boring locations, we recommend on-site observations by AET geotechnical personnel during construction to evaluate these potential changes. Soil density testing should also be performed on new fill placed in order to document that project specifications for compaction have been satisfied.

8.0 LIMITATIONS

Within the limitations of scope, budget, and schedule, we have endeavored to provide our services according to generally accepted geotechnical engineering practices at this time and location. Other than this, no warranty, express or implied, is intended.

Important information regarding risk management and proper use of this report is given in Appendix B entitled "Geotechnical Report Limitations and Guidelines for Use."

FLOOR SLAB MOISTURE/VAPOR PROTECTION

Floor slab design relative to moisture/vapor protection should consider the type and location of two elements, a granular layer and a vapor membrane (vapor retarder, water resistant barrier or vapor barrier). In the following sections, the pros and cons of the possible options regarding these elements will be presented, such that you and your specifier can make an engineering decision based on the benefits and costs of the choices.

GRANULAR LAYER

In American Concrete Institute (ACI) 302.1R-04, a "base material" is recommended over the vapor membrane, rather than the conventional clean "sand cushion" material. The base layer should be a minimum of 4 inches (100 mm) thick, trimmable, compactable, granular fill (not sand), a so-called crusher-run material. Usually graded from 1½ inches to 2 inches (38 to 50 mm) down to rock dust is suitable. Following compaction, the surface can be choked off with a fine-grade material. We refer you to ACI 302.1R-04 for additional details regarding the requirements for the base material.

In cases where potential static water levels or significant perched water sources appear near or above the floor slab, an under floor drainage system may be needed wherein a draintile system is placed within a thicker clean sand or gravel layer. Such a system should be properly engineered depending on subgrade soil types and rate/head of water inflow.

VAPOR MEMBRANE

The need for a vapor membrane depends on whether the floor slab will have a vapor sensitive covering, will have vapor sensitive items stored on the slab, or if the space above the slab will be a humidity controlled area. If the project does not have this vapor sensitivity or moisture control need, placement of a vapor membrane may not be necessary. Your decision will then relate to whether to use the ACI base material or a conventional sand cushion layer. However, if any of the above sensitivity issues apply, placement of a vapor membrane is recommended. Some floor covering systems (adhesives and flooring materials) require installation of a vapor membrane to limit the slab moisture content as a condition of their warranty.

VAPOR MEMBRANE/GRANULAR LAYER PLACEMENT

A number of issues should be considered when deciding whether to place the vapor membrane above or below the granular layer. The benefits of placing the slab on a granular layer, with the vapor membrane placed **below** the granular layer, include **reduction** of the following:

- Slab curling during the curing and drying process.
- Time of bleeding, which allows for quicker finishing.
- Vapor membrane puncturing.
- Surface blistering or delamination caused by an extended bleeding period.
- Cracking caused by plastic or drying shrinkage.

The benefits of placing the vapor membrane over the granular layer include the following:

- A lower moisture emission rate is achieved faster.
- Eliminates a potential water reservoir within the granular layer above the membrane.
- Provides a "slip surface", thereby reducing slab restraint and the associated random cracking.

If a membrane is to be used in conjunction with a granular layer, the approach recommended depends on slab usage and the construction schedule. The vapor membrane should be placed above the granular layer when:

- Vapor sensitive floor covering systems are used or vapor sensitive items will be directly placed on the slab.
- The area will be humidity controlled, but the slab will be placed before the building is enclosed and sealed from rain.
- Required by a floor covering manufacturer's system warranty.

The vapor membrane should be placed below the granular layer when:

- Used in humidity controlled areas (without vapor sensitive coverings/stored items), with the roof membrane in place, and the building enclosed to the point where precipitation will not intrude into the slab area. Consideration should be given to slight sloping of the membrane to edges where draintile or other disposal methods can alleviate potential water sources, such as pipe or roof leaks, foundation wall damp proofing failure, fire sprinkler system activation, etc.

There may be cases where membrane placement may have a detrimental effect on the subgrade support system (e.g., expansive soils). In these cases, your decision will need to weigh the cost of subgrade options and the performance risks.

FREEZING WEATHER EFFECTS ON BUILDING CONSTRUCTION

GENERAL

Because water expands upon freezing and soils contain water, soils which are allowed to freeze will heave and lose density. Upon thawing, these soils will not regain their original strength and density. The extent of heave and density/strength loss depends on the soil type and moisture condition. Heave is greater in soils with higher percentages of fines (silts/clays). High silt content soils are most susceptible, due to their high capillary rise potential which can create ice lenses. Fine grained soils generally heave about 1/4" to 3/8" for each foot of frost penetration. This can translate to 1" to 2" of total frost heave. This total amount can be significantly greater if ice lensing occurs.

DESIGN CONSIDERATIONS

Clayey and silty soils can be used as perimeter backfill, although the effect of their poor drainage and frost properties should be considered. Basement areas will have special drainage and lateral load requirements which are not discussed here. Frost heave may be critical in doorway areas. Stoops or sidewalks adjacent to doorways could be designed as structural slabs supported on frost footings with void spaces below. With this design, movements may then occur between the structural slab and the adjacent on-grade slabs. Non-frost susceptible sands (with less than 40% by weight passing a #40 sieve and no more than 5% by weight passing a #200 sieve) can be used below such areas. Depending on the function of surrounding areas, the sand layer may need a thickness transition away from the area where movement is critical. With sand placement over slower draining soils, subsurface drainage would be needed for the sand layer. High density extruded polystyrene insulation could be used within the sand to reduce frost penetration, thereby reducing the sand thickness needed. We caution that insulation placed near the surface can increase the potential for ice glazing of the surface.

The possible effects of adfreezing should be considered if clayey or silty soils are used as backfill. Adfreezing occurs when backfill adheres to rough surfaced foundation walls and lifts the wall as it freezes and heaves. This occurrence is most common with masonry block walls, unheated or poorly heated building situations and clay backfill. The potential is also increased where backfill soils are poorly compacted and become saturated. The risk of adfreezing can be decreased by placing a low friction separating layer between the wall and backfill.

Adfreezing can occur on exterior piers (such as deck, fence, or other similar pier footings), even if a smooth surface is provided. This is more likely in poor drainage situations where soils become saturated. Additional footing embedment and/or widened footings below the frost zones (which include tensile reinforcement) can be used to resist uplift forces. Specific designs would require individual analysis.

CONSTRUCTION CONSIDERATIONS

Foundations, slabs and other improvements which may be affected by frost movements should be insulated from frost penetration during freezing weather. If filling takes place during freezing weather, all frozen soils, snow and ice should be stripped from areas to be filled prior to new fill placement. The new fill should not be allowed to freeze during transit, placement or compaction. This should be considered in the project scheduling, budgeting and quantity estimating. It is usually beneficial to perform cold weather earthwork operations in small areas where grade can be attained quickly rather than working larger areas where a greater amount of frost stripping may be needed. If slab subgrade areas freeze, we recommend the subgrade be thawed prior to floor slab placement. The frost action may also require reworking and recompaction of the thawed subgrade.

Appendix A

Geotechnical Field Exploration and Testing
Boring Log Notes
Unified Soil Classification System
Figure 1 – Boring Locations
Subsurface Boring Logs

Appendix A
Geotechnical Field Exploration and Testing
Report No. 01-20471

A.1 FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling and sampling seven standard penetration test borings. The locations of the borings appear on Figure 1, preceding the Subsurface Boring Logs in this appendix.

A.2 SAMPLING METHODS

A.2.1 Split-Spoon Samples (SS) - Calibrated to N_{60} Values

Standard penetration (split-spoon) samples were collected in general accordance with ASTM: D1586 with one primary modification. The ASTM test method consists of driving a 2-inch O.D. split-barrel sampler into the in-situ soil with a 140-pound hammer dropped from a height of 30 inches. The sampler is driven a total of 18 inches into the soil. After an initial set of 6 inches, the number of hammer blows to drive the sampler the final 12 inches is known as the standard penetration resistance or N-value. Our method uses a modified hammer weight, which is determined by measuring the system energy using a Pile Driving Analyzer (PDA) and an instrumented rod.

In the past, standard penetration N-value tests were performed using a rope and cathead for the lift and drop system. The energy transferred to the split-spoon sampler was typically limited to about 60% of its potential energy due to the friction inherent in this system. This converted energy then provides what is known as an N_{60} blow count.

The most recent drill rigs incorporate an automatic hammer lift and drop system, which has higher energy efficiency and subsequently results in lower N-values than the traditional N_{60} values. By using the PDA energy measurement equipment, we are able to determine actual energy generated by the drop hammer. With the various hammer systems available, we have found highly variable energies ranging from 55% to over 100%. Therefore, the intent of AET's hammer calibrations is to vary the hammer weight such that hammer energies lie within about 60% to 65% of the theoretical energy of a 140-pound weight falling 30 inches. The current ASTM procedure acknowledges the wide variation in N-values, stating that N-values of 100% or more have been observed. Although we have not yet determined the statistical measurement uncertainty of our calibrated method to date, we can state that the accuracy deviation of the N-values using this method is significantly better than the standard ASTM Method.

A.2.2 Disturbed Samples (DS)/Spin-up Samples (SU)

Sample types described as "DS" or "SU" on the boring logs are disturbed samples, which are taken from the flights of the auger. Because the auger disturbs the samples, possible soil layering and contact depths should be considered approximate.

A.2.3 Sampling Limitations

Unless actually observed in a sample, contacts between soil layers are estimated based on the spacing of samples and the action of drilling tools. Cobbles, boulders, and other large objects generally cannot be recovered from test borings, and they may be present in the ground even if they are not noted on the boring logs.

Determining the thickness of "topsoil" layers is usually limited, due to variations in topsoil definition, sample recovery, and other factors. Visual-manual description often relies on color for determination, and transitioning changes can account for significant variation in thickness judgment. Accordingly, the topsoil thickness presented on the logs should not be the sole basis for calculating topsoil stripping depths and volumes. If more accurate information is needed relating to thickness and topsoil quality definition, alternate methods of sample retrieval and testing should be employed.

A.3 CLASSIFICATION METHODS

Soil descriptions shown on the boring logs are based on the Unified Soil Classification (USC) system. The USC system is described in ASTM: D2487 and D2488. Where laboratory classification tests (sieve analysis or Atterberg Limits) have been performed, accurate classifications per ASTM: D2487 are possible. Otherwise, soil descriptions shown on the boring logs are visual-manual judgments. Charts are attached which provide information on the USC system, the descriptive terminology, and the symbols used on the boring logs.

The boring logs include descriptions of apparent geology. The geologic depositional origin of each soil layer is interpreted primarily by observation of the soil samples, which can be limited. Observations of the surrounding topography, vegetation, and development can sometimes aid this judgment.

A.4 WATER LEVEL MEASUREMENTS

The ground water level measurements are shown at the bottom of the boring logs. The following information appears under "Water Level Measurements" on the logs:

- Date and Time of measurement
- Sampled Depth: lowest depth of soil sampling at the time of measurement
- Casing Depth: depth to bottom of casing or hollow-stem auger at time of measurement
- Cave-in Depth: depth at which measuring tape stops in the borehole
- Water Level: depth in the borehole where free water is encountered
- Drilling Fluid Level: same as Water Level, except that the liquid in the borehole is drilling fluid

The true location of the water table at the boring locations may be different than the water levels measured in the boreholes. This is possible because there are several factors that can affect the water level measurements in the borehole. Some of these factors include: permeability of each soil layer in profile, presence of perched water, amount of time between water level readings, presence of drilling fluid, weather conditions, and use of borehole casing.

A.5 LABORATORY TEST METHODS

A.5.1 Water Content Tests

Conducted per AET Procedure 01-LAB-010, which is performed in general accordance with ASTM: D2216 and AASHTO: T265.

A.6 TEST STANDARD LIMITATIONS

Field and laboratory testing is done in general conformance with the described procedures. Compliance with any other standards referenced within the specified standard is neither inferred nor implied.

A.7 SAMPLE STORAGE

Unless notified to do otherwise, we routinely retain representative samples of the soils recovered from the borings for a period of 30 days.

BORING LOG NOTES

DRILLING AND SAMPLING SYMBOLS

Symbol	Definition
AR:	Sample of material obtained from cuttings blown out the top of the borehole during air rotary procedure.
B, H, N:	Size of flush-joint casing
CAS:	Pipe casing, number indicates nominal diameter in inches
COT:	Clean-out tube
DC:	Drive casing; number indicates diameter in inches
DM:	Drilling mud or bentonite slurry
DR:	Driller (initials)
DS:	Disturbed sample from auger flights
DP:	Direct push drilling; a 2.125 inch OD outer casing with an inner 1½ inch ID plastic tube is driven continuously into the ground.
FA:	Flight auger; number indicates outside diameter in inches
HA:	Hand auger; number indicates outside diameter
HSA:	Hollow stem auger; number indicates inside diameter in inches
LG:	Field logger (initials)
MC:	Column used to describe moisture condition of samples and for the ground water level symbols
N (BPF):	Standard penetration resistance (N-value) in blows per foot (see notes)
NQ:	NQ wireline core barrel
PQ:	PQ wireline core barrel
RDA:	Rotary drilling with compressed air and roller or drag bit.
RDF:	Rotary drilling with drilling fluid and roller or drag bit
REC:	In split-spoon (see notes), direct push and thin-walled tube sampling, the recovered length (in inches) of sample. In rock coring, the length of core recovered (expressed as percent of the total core run). Zero indicates no sample recovered.
SS:	Standard split-spoon sampler (steel; 1.5" is inside diameter; 2" outside diameter); unless indicated otherwise
SU	Spin-up sample from hollow stem auger
TW:	Thin-walled tube; number indicates inside diameter in inches
WASH:	Sample of material obtained by screening returning rotary drilling fluid or by which has collected inside the borehole after "falling" through drilling fluid
WH:	Sampler advanced by static weight of drill rod and hammer
WR:	Sampler advanced by static weight of drill rod
94mm:	94 millimeter wireline core barrel
▼:	Water level directly measured in boring
▽:	Estimated water level based solely on sample appearance

TEST SYMBOLS

Symbol	Definition
CONS:	One-dimensional consolidation test
DEN:	Dry density, pcf
DST:	Direct shear test
E:	Pressuremeter Modulus, tsf
HYD:	Hydrometer analysis
LL:	Liquid Limit, %
LP:	Pressuremeter Limit Pressure, tsf
OC:	Organic Content, %
PERM:	Coefficient of permeability (K) test; F - Field; L - Laboratory
PL:	Plastic Limit, %
q_p:	Pocket Penetrometer strength, tsf (approximate)
q_c:	Static cone bearing pressure, tsf
q_u:	Unconfined compressive strength, psf
R:	Electrical Resistivity, ohm-cms
RQD:	Rock Quality Designation of Rock Core, in percent (aggregate length of core pieces 4" or more in length as a percent of total core run)
SA:	Sieve analysis
TRX:	Triaxial compression test
VSR:	Vane shear strength, remolded (field), psf
VSU:	Vane shear strength, undisturbed (field), psf
WC:	Water content, as percent of dry weight
%-200:	Percent of material finer than #200 sieve

STANDARD PENETRATION TEST NOTES
(Calibrated Hammer Weight)

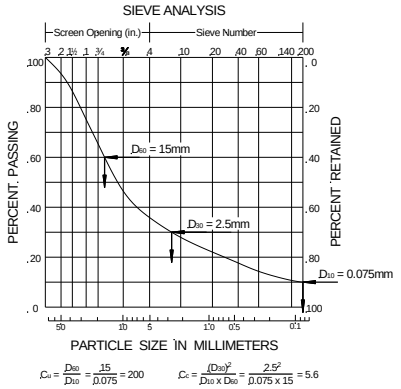
The standard penetration test consists of driving a split-spoon sampler with a drop hammer (calibrated weight varies to provide N_{60} values) and counting the number of blows applied in each of three 6" increments of penetration. If the sampler is driven less than 18" (usually in highly resistant material), permitted in ASTM: D1586, the blows for each complete 6" increment and for each partial increment is on the boring log. For partial increments, the number of blows is shown to the nearest 0.1' below the slash.

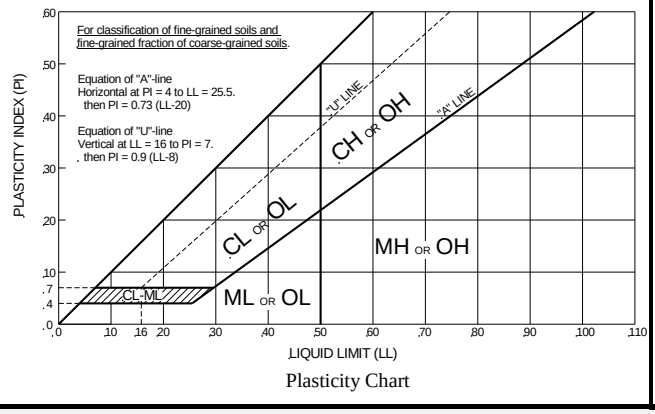
The length of sample recovered, as shown on the "REC" column, may be greater than the distance indicated in the N column. The disparity is because the N-value is recorded below the initial 6" set (unless partial penetration defined in ASTM: D1586 is encountered) whereas the length of sample recovered is for the entire sampler drive (which may even extend more than 18").

UNIFIED SOIL CLASSIFICATION SYSTEM
ASTM Designations: D 2487, D2488

AMERICAN ENGINEERING TESTING, INC.

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests[A]				Soil Classification: Group Symbol	Soil Classification: Group Name[B]
Coarse-Grained Soils More than 50% retained on No. 200 sieve	Gravels More than 50% coarse fraction retained on No. 4 sieve	Clean Gravels Less than 5% fines[C]	Cu≥4 and 1≤Cc≤3[E]	GW	Well graded gravel[F]
			Cu<4 and/or 1>Cc>3[E]	GP	Poorly graded gravel[F]
		Gravels with Fines more than 12% fines[C]	Fines classify as ML or MH	GM	Silty gravel[F,G,H]
			Fines classify as CL or CH	GC	Clayey gravel[F,G,H]
	Sands 50% or more of coarse fraction passes No. 4 sieve	Clean Sands Less than 5% fines[D]	Cu≥6 and 1≤Cc≤3[E]	SW	Well-graded sand[I]
			Cu<6 and/or 1>Cc>3[E]	SP	Poorly-graded sand[I]
		Sands with Fines more than 12% fines[D]	Fines classify as ML or MH	SM	Silty sand[G,H,I]
			Fines classify as CL or CH	SC	Clayey sand[G,H,I]
Fine-Grained Soils 50% or more passes the No. 200 sieve (see Plasticity Chart below)	Silts and Clays Liquid limit less than 50	inorganic	PI>7 and plots on or above "A" line[J]	CL	Lean clay[K,L,M]
			PI<4 or plots below "A" line[J]	ML	Silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OL	Organic clay[K,L,M,N] / Organic silt[K,L,M,O]
	Silts and Clays Liquid limit 50 or more	inorganic	PI plots on or above "A" line	CH	Fat clay[K,L,M]
			PI plots below "A" line	MH	Elastic silt[K,L,M]
		organic	Liquid limit–oven dried / Liquid limit – not dried <0.75	OH	Organic clay[K,L,M,P] / Organic silt[K,L,M,Q]
Highly organic soil			Primarily organic matter, dark in color, and organic in odor	PT	Peat[R]





Plasticity Chart

Notes

[A]Based on the material passing the 3-in (75-mm) sieve.

[B]If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C]Gravels with 5 to 12% fines require dual symbols:
GW-GM well-graded gravel with silt
GW-GC well-graded gravel with clay
GP-GM poorly graded gravel with silt
GP-GC poorly graded gravel with clay

[D]Sands with 5 to 12% fines require dual symbols:
SW-SM well-graded sand with silt
SW-SC well-graded sand with clay
SP-SM poorly graded sand with silt
SP-SC poorly graded sand with clay

[E]$Cu = D_{60} / D_{10}$, $Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$

[F]If soil contains ≥15% sand, add "with sand" to group name.

[G]If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H]If fines are organic, add "with organic fines" to group name.

[I]If soil contains ≥15% gravel, add "with gravel" to group name.

[J]If Atterberg limits plot is hatched area, soil is a CL-ML silty clay.

[K]If soil contains 15 to 29% plus No. 200 add "with sand" or "with gravel", whichever is predominant.

[L]If soil contains ≥30% plus No. 200, predominantly sand, add "sandy" to group name.

[M]If soil contains ≥30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N]PI≥4 and plots on or above "A" line.

[O]PI<4 or plots below "A" line.

[P]PI plots on or above "A" line.

[Q]PI plots below "A" line.

[R]Fiber Content description shown below.

ADDITIONAL TERMINOLOGY NOTES USED BY AET FOR SOIL IDENTIFICATION AND DESCRIPTION

Grain Size

Term	Particle Size
Boulders	Over 12"
Cobbles	3" to 12"
Gravel	#4 sieve to 3"
Sand	#200 to #4 sieve
Fines (silt & clay)	Pass #200 sieve

Gravel Percentages

Term	Percent
A Little Gravel	3% - 14%
With Gravel	15% - 29%
Gravelly	30% - 50%

Consistency of Plastic Soils

Term	N-Value, BPF
Very Soft	less than 2
Soft	2 - 4
Firm	5 - 8
Stiff	9 - 15
Very Stiff	16 - 30
Hard	Greater than 30

Relative Density of Non-Plastic Soils

Term	N-Value, BPF
Very Loose	0 - 4
Loose	5 - 10
Medium Dense	11 - 30
Dense	31 - 50
Very Dense	Greater than 50

Moisture/Frost Condition

(MC Column)

D (Dry): Absence of moisture, dusty, dry to touch.

M (Moist): Damp, although free water not visible. Soil may still have a high water content (over "optimum").

W (Wet/ Waterbearing): Free water visible, intended to describe non-plastic soils. Waterbearing usually relates to sands and sand with silt.

F (Frozen): Soil frozen

Layering Notes

Laminations: Layers less than ½" thick of differing material or color.

Lenses: Pockets or layers greater than ½" thick of differing material or color.

Peat Description

Term	Fiber Content (Visual Estimate)
Fibric Peat:	Greater than 67%
Hemic Peat:	33 – 67%
Sapric Peat:	Less than 33%

Organic Description (if no lab tests)

Soils are described as *organic*, if soil is not peat and is judged to have sufficient organic fines content to influence the Liquid Limit properties. *Slightly organic* used for borderline cases.

Root Inclusions

With roots: Judged to have sufficient quantity of roots to influence the soil properties.

Trace roots: Small roots present, but not judged to be in sufficient quantity to significantly affect soil properties.

AMERICAN ENGINEERING TESTING, INC.	**PROJECT** Cleary Maintenance Shop			**AET NO.** 01-20471
	SUBJECT Boring Locations			**DATE** June 2019
	SCALE N.T.S.	**DRAWN BY** KEZ	**CHECKED BY** WKC	**FIGURE 1**

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-1 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **961.4** Co. Coordinates: N **175751** E **479885**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mixture of clayey sand and silty sand, a little gravel, trace roots, dark brown and brown	FILL	6	M	SS	12	15				
3	SANDY LEAN CLAY, a little gravel, brown, firm (CL) (possible fill)	TILL OR FILL	7	M	SS	14	20				
5	SILTY SAND, a little gravel, fine to medium grained, brown, moist, loose (SM)	COARSE ALLUVIUM	9	M	SS	14					
8	SAND WITH SILT, a little gravel, medium to fine grained, brown, moist, loose (SP-SM)		6	M	SS	12					
10	SANDY LEAN CLAY, a little gravel, grayish brown, a little dark brown, stiff, laminations of sandy silt (CL)	TILL	10	M	SS	18	21				
12	CLAYEY SAND, a little gravel, brownish gray, a little dark brown, stiff, laminations of sandy silt (SC)						17				
13	SILTY SAND, a little gravel, fine grained, brown, a little gray, moist, medium dense (SM)	COARSE ALLUVIUM	12	M	SS	18					
15	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist, loose (SP-SM)		10	M	SS	12					
18	SAND, a little gravel, fine to medium grained, brown, moist, medium dense (SP)										
20			20	M	SS	12					
21	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
0-19½' 3.25" HSA	**6/10/19**	**10:25**	**21.0**	**19.5**	**20.9**		**None**	
BORING COMPLETED: **6/10/19**								
DR: **DA** LG: **RG** Rig: **27C**								

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-2 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **961.8** Co. Coordinates: N **175704** E **479894**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly sandy lean clay, a little gravel, trace roots, brown and dark brown	FILL	5	M	SS	8	18				
3	FILL, mostly sandy lean clay, a little silty sand and gravel, brown		7	M	SS	10	22				
5	FILL, mostly sand with silt, a little sandy lean clay and gravel, brown		7	M	SS	8					
8	FILL, mostly sand with silt and gravel, brown and dark brown		8	M	SS	16					
10	SANDY LEAN CLAY, a little gravel, grayish brown, a little dark brown, firm, laminations of sandy silt (CL)	TILL	6	M	SS	24	21				
13	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist, loose (SP-SM)	COARSE ALLUVIUM	9	M	SS	16					
15	SAND WITH SILT, a little gravel, fine to medium grained, brown, moist, medium dense (SP-SM)		11	M	SS	14					
18	SAND WITH GRAVEL, medium to fine grained, light brown, moist, medium dense (SP)										
20			20	M	SS	10					
21	**END OF BORING**										

DEPTH: DRILLING METHOD

0-19½' 3.25" HSA

BORING COMPLETED: **6/10/19**

DR: **DA** LG: **RG** Rig: **27C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/10/19	**12:45**	**21.0**	**19.5**	**20.9**		**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-3 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **961.9** Co. Coordinates: N **175637** E **479893**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown	FILL	6	M	SS	16	20				
2	FILL, mostly clayey sand, a little gravel, trace roots, brown						13				
3	SANDY LEAN CLAY, a little gravel, brown, soft (CL) (possible fill)	TILL OR FILL	4	M	SS	10	26				
5	SANDY LEAN CLAY, a little gravel, brown, a little light brown, stiff, laminations of sandy silt (CL)	TILL	9	M	SS	4	20				
8			12	M	SS	16	20				
10	SANDY LEAN CLAY, a little gravel, brown, gray, a little brown, stiff, laminations of sandy silt (CL)		12	M	SS	22	21				
13	SILTY SAND, a little gravel, fine to medium grained, brown, moist, medium dense (SM)	COARSE ALLUVIUM	14	M	SS	18					
15	SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, medium dense (SP-SM)		13	M	SS	12					
18	SAND WITH GRAVEL, medium to fine grained, brown, moist, medium dense (SP)										
20			24	M	SS	14					
21	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-19½' 3.25" HSA	**6/10/19**	**1:40**	**21.0**	**19.5**	**21.0**		**None**
BORING COMPLETED: **6/10/19**							
DR: **DA** LG: **RG** Rig: **27C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-4 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **960.3** Co. Coordinates: N **175747** E **479836**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown	FILL	4	M	SS	16	20				
2	FILL, mostly sandy lean clay, a little gravel, brown, a little dark brown						18				
3			7	M	SS	14	21				
4											
5	SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, medium dense (SP-SM) (possible fill)	COARSE ALLUVIUM OR FILL	18	M	SS	14					
6											
7											
8	SILTY SAND WITH GRAVEL, fine to medium grained, brown, moist, medium dense (SM) (possible fill)		26	M	SS	2					
9											
10	SANDY LEAN CLAY, a little gravel, brownish gray, a little dark brown, stiff, laminations of sandy silt (CL)	TILL	12	M	SS	20	22				
11											
12	CLAYEY SAND, a little gravel, grayish brown, a little dark brown, very stiff, laminations of sandy silt and silty sand (SC)										
13			18	M	SS	20	18				
14	SAND WITH SILT, fine grained, brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM									
15	SILTY SAND, fine grained, brown, moist, medium dense (SM)		24	M	SS	12					
16											
17											
18	SAND WITH GRAVEL, medium to fine grained, brown, moist, medium dense (SP)										
19											
20			28	M	SS	16					
21	**END OF BORING**										

DEPTH: DRILLING METHOD **0-19½' 3.25" HSA**

BORING COMPLETED: **6/10/19**

DR: **DA** LG: **RG** Rig: **27C**

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
6/10/19	**11:30**	**21.0**	**19.5**	**21.0**		**None**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-5 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **961.6** Co. Coordinates: N **175692** E **479834**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	WC	DEN	LL	PL	%-#200
0–2	FILL, mostly clayey sand with organic fines, a little gravel, trace roots, dark brown	FILL	5	M	SS	12	19				
2–4.5	SANDY LEAN CLAY, a little gravel, brown, a little light brown, firm, laminations of sandy silt (CL) (possible fill)	TILL OR FILL	8	M	SS	12	20				
4.5–6.5	SAND WITH SILT, a little gravel, medium to fine grained, brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM	19	M	SS	14					
6.5–9.5	SILTY SAND, a little gravel, medium to fine grained, brown, moist, medium dense (SM)		19	M	SS	16					
9.5–12	SANDY LEAN CLAY, a little gravel, brown, stiff, lenses and laminations of silty sand (CL)	TILL	14	W	SS	16	15				
12–13.5	SANDY LEAN CLAY, a little gravel, brownish gray, a little brown, stiff, laminations of sandy silt (CL)		14	M	SS	22	23				
13.5–14.5	SAND WITH SILT, fine grained, light brown, moist, medium dense (SP-SM)	COARSE ALLUVIUM									
14.5–18	SILTY SAND, a little gravel, fine to medium grained, brown, moist, medium dense (SM)		21	M	SS	14					
18–21	SAND WITH SILT AND GRAVEL, fine to medium grained, brown, moist, dense (SP-SM)		37	M	SS	12					
21	**END OF BORING**										

DEPTH:	DRILLING METHOD	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-19½'	**3.25" HSA**							
		6/7/19	**1:45**	**21.0**	**19.5**	**17.3**		**15.1**
		6/10/19	**8:15**	**21.0**	**19.5**	**16.8**		**14.7**

BORING COMPLETED: **6/7/19**

DR: **DS** LG: **RG** Rig: **27C**

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-6 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **961.0** Co. Coordinates: N **175639** E **479838**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mixture of clayey sand and silty sand with organic fines, a little gravel, trace roots, dark brown and brown	FILL	5	M	SS	10	22				
3	SANDY LEAN CLAY, a little gravel, trace roots, brown, firm (CL) (possible fill)	TILL OR FILL	7	M	SS	12	23				
5	SANDY LEAN CLAY, a little gravel, brown, a little light brown, stiff, laminations of sandy silt (CL) (possible fill)		11	M	SS	20	21				
8	CLAYEY SAND, a little gravel, brown, firm, lenses and laminations of silty sand (SC) (possible fill)		6	M	SS	12	14				
10	SANDY LEAN CLAY, a little gravel, brown, a little gray and light gray, stiff, laminations of sandy silt (CL)	TILL	11	M	SS	18	21				
13	CLAYEY SAND, a little gravel, brown, very stiff (SC)		17	M	SS	20	18				
15	SILTY SAND, fine grained, brown, moist, medium dense (SM)	COARSE ALLUVIUM	21	M	SS	16					
18	SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, dense (SP-SM)										
20			33	M	SS	14					
21	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS						
	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL
0-19½' 3.25" HSA	**6/7/19**	**12:15**	**21.0**	**19.5**			**None**
BORING COMPLETED: **6/7/19**							
DR: **DS** LG: **RG** Rig: **27C**							

NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

AMERICAN ENGINEERING TESTING, INC.

SUBSURFACE BORING LOG

AET No: **01-20471** Log of Boring No. **B-7 (p. 1 of 1)**

Project: **Cleary Maintenance Shop; 6246 190th Street East; Prior Lake, MN**

Surface Elevation **958.9** Co. Coordinates: N **175723** E **479810**

DEPTH IN FEET	MATERIAL DESCRIPTION	GEOLOGY	N	MC	SAMPLE TYPE	REC IN.	FIELD & LABORATORY TESTS WC	DEN	LL	PL	%-#200
1	FILL, mixture of silty sand and clayey sand with organic fines, a little gravel, trace roots, dark brown	FILL	6	M	SS	18	16				
2	FILL, mostly clayey sand, a little silty sand and gravel, brown						10				
3	FILL, mostly sandy lean clay, a little gravel, brown, a little dark brown		8	M	SS	14	22				
4											
5	FILL, mixture of sandy lean clay and clayey sand, a little gravel, brown, light brown and gray										
6	SILTY SAND, a little gravel, fine to medium grained, brown, moist, medium dense (SM)	COARSE ALLUVIUM	15	M	SS	18	17				
7											
8	SILTY SAND WITH GRAVEL, medium to fine grained, brown, wet, medium dense (SM)		14	W	SS	16					
9											
10											
11			15	W	SS	16					
12											
13	SANDY LEAN CLAY, a little gravel, brownish gray, stiff (CL)	TILL	14	M	SS	14	23				
14											
15	SILTY SAND, a little gravel, fine to medium grained, brown, moist, medium dense (SM)	COARSE ALLUVIUM	24	M	SS	14					
16											
17											
18	SAND WITH SILT AND GRAVEL, medium to fine grained, brown, moist, dense (SP-SM)										
19				▽							
20			32	M	SS	12					
21	**END OF BORING**										

DEPTH: DRILLING METHOD	WATER LEVEL MEASUREMENTS							NOTE: REFER TO THE ATTACHED SHEETS FOR AN EXPLANATION OF TERMINOLOGY ON THIS LOG
0-19½' 3.25" HSA	DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	DRILLING FLUID LEVEL	WATER LEVEL	
	6/10/19	**9:00**	**11.5**	**9.5**	**10.0**		**8.0**	
	6/10/19	**9:10**	**11.5**	**9.5**	**10.0**		**7.9**	
BORING COMPLETED: **6/10/19**	**6/10/19**	**9:30**	**21.0**	**19.5**	**21.0**		**19.1**	
DR: **DA** LG: **RG** Rig: **27C**								

AET_CORP W-COORDINATES 01-20471.GPJ AET+CPT+WELL_20181012_JG.GDT 6/27/19

Appendix B

Geotechnical Report Limitations and Guidelines for Use

Appendix B
Geotechnical Report Limitations and Guidelines for Use
Report No. 01-20471

B.1 REFERENCE

This appendix provides information to help you manage your risks relating to subsurface problems which are caused by construction delays, cost overruns, claims, and disputes. This information was developed and provided by ASFE[1], of which, we are a member firm.

B.2 RISK MANAGEMENT INFORMATION

B.2.1 Geotechnical Services are Performed for Specific Purposes, Persons, and Projects

Geotechnical engineers structure their services to meet the specific needs of their clients. A geotechnical engineering study conducted for a civil engineer may not fulfill the needs of a construction contractor or even another civil engineer. Because each geotechnical engineering study is unique, each geotechnical engineering report is unique, prepared solely for the client. No one except you should rely on your geotechnical engineering report without first conferring with the geotechnical engineer who prepared it. And no one, not even you, should apply the report for any purpose or project except the one originally contemplated.

B.2.2 Read the Full Report

Serious problems have occurred because those relying on a geotechnical engineering report did not read it all. Do not rely on an executive summary. Do not read selected elements only.

B.2.3 A Geotechnical Engineering Report is Based on A Unique Set of Project-Specific Factors

Geotechnical engineers consider a number of unique, project-specific factors when establishing the scope of a study. Typically, factors include: the client's goals, objectives, and risk management preferences; the general nature of the structure involved, its size, and configuration; the location of the structure on the site; and other planned or existing site improvements, such as access roads, parking lots, and underground utilities. Unless the geotechnical engineer who conducted the study specifically indicates otherwise, do not rely on a geotechnical engineering report that was:

- not prepared for you,
- not prepared for your project,
- not prepared for the specific site explored, or
- completed before important project changes were made.

Typical changes that can erode the reliability of an existing geotechnical engineering report include those that affect:

- the function of the proposed structure, as when it's changed from a parking garage to an office building, or from a light industrial plant to a refrigerated warehouse,
- elevation, configuration, location, orientation, or weight of the proposed structure,
- composition of the design team, or
- project ownership.

As a general rule, always inform your geotechnical engineer of project changes, even minor ones, and request an assessment of their impact. Geotechnical engineers cannot accept responsibility or liability for problems that occur because their reports do not consider developments of which they were not informed.

B.2.4 Subsurface Conditions Can Change

A geotechnical engineering report is based on conditions that existed at the time the study was performed. Do not rely on a geotechnical engineering report whose adequacy may have been affected by: the passage of time; by man-made events, such as construction on or adjacent to the site; or by natural events, such as floods, earthquakes, or groundwater fluctuations. Always contact the geotechnical engineer before applying the report to determine if it is still reliable. A minor amount of additional testing or analysis could prevent major problems.

B.2.5 Most Geotechnical Findings Are Professional Opinions

Site exploration identified subsurface conditions only at those points where subsurface tests are conducted or samples are taken. Geotechnical engineers review field and laboratory data and then apply their professional judgment to render an opinion about subsurface conditions throughout the site. Actual subsurface conditions may differ, sometimes significantly, from those indicated in

[1] Geoprofessional Business Association, 1300 Piccard Drive, LL14, Rockford, MD 20850; Telephone: 301/565-2733: www.geoprofessional.org

your report. Retaining the geotechnical engineer who developed your report to provide construction observation is the most effective method of managing the risks associated with unanticipated conditions.

B.2.6 A Report's Recommendations Are Not Final

Do not over rely on the construction recommendations included in your report. Those recommendations are not final, because geotechnical engineers develop them principally from judgment and opinion. Geotechnical engineers can finalize their recommendations only by observing actual subsurface conditions revealed during construction. The geotechnical engineer who developed your report cannot assume responsibility or liability for the report's recommendations if that engineer does not perform construction observation.

B.2.7 A Geotechnical Engineering Report Is Subject to Misinterpretation

Other design team members' misinterpretation of geotechnical engineering reports has resulted in costly problems. Lower that risk by having your geotechnical engineer confer with appropriate members of the design team after submitting the report. Also retain your geotechnical engineer to review pertinent elements of the design team's plans and specifications. Contractors can also misinterpret a geotechnical engineering report. Reduce that risk by having your geotechnical engineer participate in prebid and preconstruction conferences, and by providing construction observation.

B.2.8 Do Not Redraw the Engineer's Logs

Geotechnical engineers prepare final boring and testing logs based upon their interpretation of field logs and laboratory data. To prevent errors or omissions, the logs included in a geotechnical engineering report should never be redrawn for inclusion in architectural or other design drawings. Only photographic or electronic reproduction is acceptable, but recognizes that separating logs from the report can elevate risk.

B.2.9 Give Contractors a Complete Report and Guidance

Some owners and design professionals mistakenly believe they can make contractors liable for unanticipated subsurface conditions by limiting what they provide for bid preparation. To help prevent costly problems, give contractors the complete geotechnical engineering report, but preface it with a clearly written letter of transmittal. In the letter, advise contractors that the report was not prepared for purposes of bid development and that the report's accuracy is limited; encourage them to confer with the geotechnical engineer who prepared the report (a modest fee may be required) and/or to conduct additional study to obtain the specific types of information they need or prefer. A prebid conference can also be valuable. Be sure contractors have sufficient time to perform additional study. Only then might you be in a position to give contractors the best information available to you, while requiring them to at least share some of the financial responsibilities stemming from unanticipated conditions.

B.2.10 Read Responsibility Provisions Closely

Some clients, design professionals, and contractors do not recognize that geotechnical engineering is far less exact than other engineering disciplines. This lack of understanding has created unrealistic expectations that have led to disappointments, claims, and disputes. To help reduce the risk of such outcomes, geotechnical engineers commonly include a variety of explanatory provisions in their report. Sometimes labeled "limitations" many of these provisions indicate where geotechnical engineers' responsibilities begin and end, to help others recognize their own responsibilities and risks. Read these provisions closely. Ask questions. Your geotechnical engineer should respond fully and frankly.

B.2.11 Geoenvironmental Concerns Are Not Covered

The equipment, techniques, and personnel used to perform a geoenvironmental study differ significantly from those used to perform a geotechnical study. For that reason, a geotechnical engineering report does not usually relate any geoenvironmental findings, conclusions, or recommendations; e.g., about the likelihood of encountering underground storage tanks or regulated contaminants. Unanticipated environmental problems have led to numerous project failures. If you have not yet obtained your own geoenvironmental information, ask your geotechnical consultant for risk management guidance. Do not rely on an environmental report prepared for someone else.

DOCUMENT 00 41 00 - BID FORM

From: Bidder _____

To: Scott County Public Works
600 Country Trail East
Jordan, MN 55352

Time: 2:00 PM
Date: August 15, 2019

ATTN: Scott County Purchasing Department

RE: **Cleary Lake Regional Park Maintenance Building**

Base Bid:

The undersigned has examined the contract documents, consisting of the Agreement between Owner and Contractor (hereinafter the Agreement), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, and Addenda and is familiar with the site and location of the project, the nature of the work and local conditions affecting the cost of the work and hereby proposes to furnish all labor, materials, and equipment required for completing the work as described, in strict conformance with all requirements of the Bidding Documents for the Total Base Bid amount of:

_____ DOLLARS

($_____)

Alternates:

Alternate #1: Provide complete electrical service to the outbuildings (Add):

_____ DOLLARS ($_____)

Alternate #2: In lieu of concrete slab and class V aggregate parking area, provide asphalt pavement as shown on the drawings. (Add):

_____ DOLLARS ($_____)

Alternate #3: In lieu of base bid nominal 15" x 10" metal panel system, provide horizontal siding as specified (Add or deduct – cross out preceding nonapplicable item.)

_____ DOLLARS ($_____)

Alternate #4: Provide metal lockers as specified (Add):

_____ DOLLARS ($_____)

Alternate #5: Eliminate the operable wall panel system and provide a continuous acoustic ceiling between room #112 and #112A. (Deduct)

_____ DOLLARS ($_____)

Alternate #6: Provide fully adhered EPDM roofing system in lieu of Structural Standing Seam Metal Roofing / Insulation sections. (Deduct)

_____ DOLLARS ($_____)

All Bidders shall submit the following information with their Bid, subject to rejection:

1. Bid Security – Five Percent (5%) of Total Base Bid

2. Responsible Contractor Verification and Certification Compliance Form (Attachment A and Attachment A-1)

Bid security in the amount of at least five percent (5%) of the Total Base Bid accompanies this Bid, the same being subject to forfeiture in the event of default.

The undersigned acknowledges receipt of the following Addenda:

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____
_____	_____

The Contractor agrees to commence said work as herein provided at the earliest practicable date and in any event not later than September 3, 2019 and to prosecute the same diligently and without delay and substantially complete this work no later than May 31, 2020 [and] the Work shall be finally complete on or before June 15, 2020.

It is understood by the undersigned that the Owner reserves the right to reject any or all bids and to waive irregularities and formalities in order to serve the best interests of the Owner and that this bid may not be withdrawn until sixty (60) calendar days after the date of opening.

It is understood that if accepted by the Owner, this Bid becomes a part of the Contract documents, and failing to comply with any part of this Bid will be taken as failure of the bidder to comply with the Contract Documents and will be just cause for rejection of the work.

Respectfully Submitted: Bidder is (Corporation) (Partnership) (Individual)

Firm: _____

By: _____

Title: _____

Address: _____

_____Zip Code_____

Telephone: _____

END OF DOCUMENT 00 41 00

DOCUMENT 00 45 13- RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION COMPLIANCE

1. Responsible Contractor:

   The Owner cannot award a construction contract in excess of $50,000 unless the Bidder is a "responsible contractor" as defined in Minnesota Statutes §16C.285, subdivision 3. A Bidder submitting a Proposal for this Project must verify that it meets the minimum criteria specified in that statute by submitting the Responsible Contractor Verification and Certification of Compliance form (Attachment A). A company owner or officer must sign the Responsible Contractor Verification and Certification of Compliance form under oath verifying compliance with each of the minimum criteria. Bidders must obtain verifications of compliance from all subcontractors. A Bidder must submit signed copies of verifications and certifications of compliance from subcontractors upon the Owner's request.

   A Bidder or subcontractor who does not meet the minimum criteria established in Minnesota Statutes §16C.285, subdivision 3, or who fails to verify compliance with the criteria, will not be a "responsible contractor" and will be ineligible to be awarded the Contract for this Project or to work on this Project. Making a false statement verifying compliance with any of the minimum criteria will render the Bidder or subcontractor ineligible to be awarded a construction contract for this Project and may result in the termination of a contract awarded to a Bidder or subcontractor that makes a false statement.

   A Bidder must also identify each subcontractor it intends to use on the Project. A Bidder must complete Attachment A-1 and submit it with the Responsible Contractor Verification and Certification of Compliance form (Attachment A), identifying each subcontractor it intends to use as of the time of bid submission. THE COMPLETED FORMS MUST BE SUBMITTED WITH THE BID PROPOSAL.

   If the Bidder retains additional subcontractors after submitting its Responsible Contractor Verification and Certification of Compliance form, then the Bidder must submit Attachment A-2 within 14 days of retaining the additional subcontractor. Documents must be submitted to the Project Engineer. Include the State Project number specific to the bid on the form**.**

   For Projects in excess of $50,000, the Contractor may sublet work only to subcontractors that meet the definition of "responsible contractor" in Minnesota Statutes §16C.285, subdivision 3. The Contractor is responsible for obtaining verifications of compliance with §16C.285 from subcontractors using a form provided by the Department. The Contractor must provide such verifications to the Department upon the Department's request.

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE
ATTACHMENT A

PROJECT NUMBER CLE 1901

Minn. Stat. § 16C.285, Subd. 7. IMPLEMENTATION. ... any prime contractor or subcontractor that does not meet the minimum criteria in subdivision 3 or fails to verify that it meets those criteria is not a responsible contractor and is not eligible to be awarded a construction contract for the project or to perform work on the project...	
Minn. Stat. § 16C.285, Subd. 3. RESPONSIBLE CONTRACTOR, MINNIMUM CRITERIA. "Responsible contractor" means a contractor that conforms to the responsibility requirements in the solicitation document for its portion of the work on the project and verifies that it meets the following minimum criteria:	
(1)	The Contractor: (i) is in compliance with workers' compensation and unemployment insurance requirements; (ii) is currently registered with the Department of Revenue and the Department of Employment and Economic Development if it has employees; (iii) has a valid federal tax identification number or a valid Social Security number if an individual; and (iv) has filed a certificate of authority to transact business in Minnesota with the Secretary of State if a foreign corporation or cooperative.
(2)	The contractor or related entity is in compliance with and, during the three-year period before submitting the verification, has not violated section 177.24, 177.25, 177.41 to 177.44, 181.13, 181.14, or 181.722, and has not violated United States Code, title 29, sections 201 to 219, or United States Code, title 40, sections 3141 to 3148. For purposes of this clause, a violation occurs when a contractor or related entity: (i) repeatedly fails to pay statutorily required wages or penalties on one or more separate projects for a total underpayment of $25,000 or more within the three-year period; (ii) has been issued an order to comply by the commissioner of Labor and Industry that has become final; (iii) has been issued at least two determination letters within the three-year period by the Department of Transportation finding an underpayment by the contractor or related entity to its own employees; (iv) has been found by the commissioner of Labor and Industry to have repeatedly or willfully violated any of the sections referenced in this clause pursuant to section 177.27; (v) has been issued a ruling or findings of underpayment by the administrator of the Wage and Hour Division of the United States Department of Labor that have become final or have been upheld by an administrative law judge or the Administrative Review Board; or (vi) has been found liable for underpayment of wages or penalties or misrepresenting a construction worker as an independent contractor in an action brought in a court having jurisdiction. Provided that, if the contractor or related entity contests a determination of underpayment by the Department of Transportation in a contested case proceeding, a violation does not occur until the contested case proceeding has concluded with a determination that the contractor or related entity underpaid wages or penalties;'

(3)	The contractor or related entity is in compliance with and, during the three-year period before submitting the verification, has not violated section 181.723 or chapter 3268. For purposes of this clause, a violation occurs when a contractor or related entity has been issued a final administrative or licensing order;'
(4)	The contractor or related entity has not, more than twice during the three-year period before submitting the verification, had a certificate of compliance under section 363A.36 revoked or suspended based on the provisions of section 363A.36, with the revocation or suspension becoming final because it was upheld by the Office of Administrative Hearing or was not appealed to the office;'
(5)	The contractor or related entity has not received a final determination assessing a monetary sanction from the Department of Administration or Transportation for failure to meet targeted group business, disadvantaged business enterprise, or veteran-owned business goals, due to a lack of good faith effort, more than once during the three-year period before submitting the verification;'
	* Any violations, suspensions, revocations, or sanctions, as defined in clauses (2) to (5), occurring prior to July 1, 2014, shall not be considered in determining whether a contractor or related entity meets the minimum criteria.
(6)	The contractor or related entity is not currently suspended or debarred by the federal government or the state of Minnesota or any of its departments, commissions, agencies, or political subdivisions; and
(7)	All subcontractors that the contractor intends to use to perform project work have verified to the contractor through a signed statement under oath by an owner or officer that they meet the minimum criteria listed in clauses (1) to (6).

Minn. Stat. § l6C.285, Subd. 5. **SUBCONTRACTOR VERIFICATION.**

A prime contractor or subcontractor shall include in its verification of compliance under subdivision 4 a list of all of its first-tier subcontractors that it intends to retain for work on the project (Attachment A-1).

If a prime contractor or any subcontractor retains additional subcontractors on the project after submitting its verification of compliance, the prime contractor or subcontractor shall obtain verifications of compliance from each additional subcontractor with which it has a direct contractual relationship and shall submit a supplemental verification (Attachment A-2) confirming compliance with subdivision 3, clause (7), within 14 days of retaining the additional subcontractors.

A prime contractor shall submit to the contracting authority upon request copies of the signed verifications of compliance from all subcontractors of any tier pursuant to subdivision 3, clause (7). A prime contractor and subcontractors shall not be responsible for the false statements of any subcontractor with which they do not have a direct contractual relationship. A prime contractor and subcontractors shall be responsible for false statements by their first-tier subcontractors with which they have a direct contractual relationship only if they accept the verification of compliance with actual knowledge that it contains a false statement.

Minn. Stat. § 16C.285, Subd. 4. VERIFICATION OF COMPLIANCE.

A contractor responding to a solicitation document of a contracting authority shall submit to the contracting authority a signed statement under oath by an owner or officer verifying compliance with each of the minimum criteria in subdivision 3 at the time that it responds to the solicitation document.

A contracting authority may accept a sworn statement as sufficient to demonstrate that a contractor is a responsible contractor and shall not be held liable for awarding a contract in reasonable reliance on that statement. Failure to verify compliance with any one of the minimum criteria or a false statement under oath in a verification of compliance shall render the prime contractor or subcontractor that makes the false statement ineligible to be awarded a construction contract on the project for which the verification was submitted.

A false statement under oath verifying compliance with any of the minimum criteria may result in termination of a construction contract that has already been awarded to a prime contractor or subcontractor that submits a false statement. A contracting authority shall not be liable for declining to award a contract or terminating a contract based on a reasonable determination that the contractor failed to verify compliance with the minimum criteria or falsely stated that it meets the minimum criteria.

CERTIFICATION

By signing this document I certify that I am an owner or officer of the company, and I swear under oath that:

1) My company meets each of the Minimum Criteria to be a responsible contractor as defined herein and is in compliance with Minn. Stat. § 16C.285,

2) I have included Attachment A-1 with my company's solicitation response, and

3) if my company is awarded a contract, I will also submit Attachment A-2 as required.

Authorized Signature of Owner or Officer:	Printed Name:
Title:	Date:
Company Name:	

Sworn to and subscribed before me this

_____day of _____, 20__.

PLACE NOTARY SEAL HERE

_____
Notary Public

My Commission Expires: _____

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE
ATTACHMENT A-1

FIRST-TIER SUBCONTRACTORS LIST

SUBMIT WITH PRIME CONTRACTOR

RESPONSE

PROJECT NUMBER CLE 1901

Minn. Stat. § 16C.285, Subd. 5. A prime contractor or subcontractor shall include in its verification of compliance under subdivision 4 a list of all of its first-tier subcontractors that it intends to retain for work on the project.

FIRST TIER SUBCONTRACTOR NAMES (Legal name of company as registered with the Secretary of State)	Name of city where company home office is located

RESPONSIBLE CONTRACTOR VERIFICATION AND CERTIFICATION OF COMPLIANCE
ATTACHMENT A-2

ADDITIONAL SUBCONTRACTORS LIST

PRIME CONTACTOR TO SUBMIT AS SUBCONTRACTORS ARE ADDED TO THE PROJECT

PROJECT NUMBER CLE 1901

This form must be submitted to the Owner.

Minn. Stat. § l6C.285, Subd. 5. ... If a prime contractor or any subcontractor retains additional subcontractors on the project after submitting its verification of compliance, the prime contractor or subcontractor shall obtain verifications of compliance from each additional subcontractor with which it has a direct contractual relationship and shall submit a supplemental verification confirming compliance with subdivision 3, clause (7), within l4 days of retaining the additional subcontractors.

ADDITIONAL SUBCONTRACTOR NAMES (Legal name of company as registered with the Secretary of State)	Name of city where company home office is located

ADDITIONAL SUBCONTRACTOR NAMES (Legal name of company as registered with the Secretary of State)	Name of city where company home office is located

SUPPLEMENTAL CERTIFICATION FOR ATTACHMENT A-2

By signing this document I certify that I am an owner or officer of the company, and I swear under oath that:

All additional subcontractors listed on Attachment A-2 have verified through a signed statement under oath by an owner or officer that they meet the minimum criteria to be a responsible contractor as defined in Minn. Stat. § 16C.285.

Authorized Signature of Owner or Officer:	Printed Name:
Title:	Date:
Company Name:	

Sworn to and subscribed before me this

_____day of _____, 20__ .

PLACE NOTARY SEAL HERE

_____
Notary Public

My Commission Expires: _____

END OF DOCUMENT 004513

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DOCUMENT 00 52 00 - AGREEMENT FORM

Contract No:

Date of Award:

Contract For: Cleary Lake Regional Park Maintenance Building

Agreement:

This Agreement is entered into under the authority granted by Scott County's Board of Commissioners at its regular meeting on August 20, 2019 and after the consideration of sealed bids which were submitted to Scott County at a public opening at 2:00 PM on August 15, 2019. The Agreement is between Scott County existing under the laws of the State of Minnesota, hereinafter referred to as the Owner, party of the first part, and _____ hereinafter called the Contractor, party of the second part.

Witnesseth:

Article 1:

The Contractor, for and in consideration of the payment or payments, herein specified, hereby covenants and agrees to perform all Work as indicated and related on the attached Bid Form for the completion of the Work in strict conformance with the Contract Documents consisting of this Agreement between Owner and Contractor (hereinafter the Agreement), Conditions of the Contract (General, Supplementary and other Conditions), Drawings, Specifications, Addenda issued prior to execution of the Contract, other documents listed in the Agreement and Modifications issued after execution of the Contract. Said Contract Documents are hereby referred to and made a part of this Contract to the same extent as if herein set forth.

Article 2:

Equal Employment and Americans with Disabilities:

The Contractor agrees to comply with the applicable provisions of state and federal equal employment opportunity and nondiscrimination statutes and regulations. In addition, the Contractor certifies that it has been made fully aware of Scott County’s Equal Employment Opportunity and Americans with Disabilities Act Policy, attached hereto and incorporated herein as Exhibit A through both oral and written communications, that it supports this policy and that it will conduct its own employment practices in accordance therewith. Failure on the part of the Contractor to conduct its own employment practices in accordance with County Policy may result in the withholding of all or part of regular payments by the County due under this agreement unless or until the Contractor complies with the County policy, and/or suspension or termination of the agreement.

Article 3:

The current minimum wage rate per hour to be paid for each classification of work shall be the local prevailing rate, including fringe benefits as defined in Minnesota Statute 177.41-177.44.

Article 4:

The Contractor agrees to commence said work as herein provided at the earliest practicable date and in any event not later than September 3, 2019 and to prosecute the same diligently and without delay, and substantially complete this work no later than May 31, 2020.

Article 5:

The Contractor further agrees to make, execute and deliver to the Owner, a Performance Bond and Labor and Material Payment Bond executed by himself and a surety company approved by the Owner, each in the sum of _____, for the use of said Owner and of all persons doing work or furnishing skill, tools, machinery or materials under or for the purpose of this Contract by said Contractor, and this Contract shall not become effective until said Bonds have been received and approved by the Owner.

Article 6:

In consideration of the covenants and agreements stated above, the Owner agrees to pay the Contractor the Contract Sum of $ as mentioned in the Bid of said Contractor which is made a part of this Contract and attached hereto. Installment payments, if any, on account of work done and the materials furnished by said Contractor under this Contract and actually in place in said project, shall be made in accordance with the provisions of the General Contract Conditions and final payment therefore shall be due and payable on or before thirty (30) days after receipt by the Owner of a certificate by the Owner's representative that the work has been fully completed and this Contract fully performed by the Contractor and the opinion of the Owner's attorney that the Owner is then obligated to pay the sum contracted for herein.

IN WITNESS WHEREOF, the parties have caused this agreement to be duly executed intending to be bound thereby.

SCOTT COUNTY

by_____
Barb Weckman Brekke
Scott County Board of Commissioners

Date_____

CONTRACTOR

by_____
Name
Title

Date_____

Attest_____
Lezlie Vermillion
Scott County Administrator

Date_____

Approved as to form:

_____
Jeanne Andersen
Assistant Scott County Attorney

_____
Date

END OF DOCUMENT 00 52 00

EXHIBIT A

POLICY STATEMENT

It is the policy of Scott County Government to provide Equal Opportunity to all employees and applicants for employment in accordance with all applicable Equal Employment Opportunity laws, directives, and regulations of Federal, State, and local governing bodies or agencies thereof, including Minnesota Statutes, Chapter 363A.

Scott County will not engage in any employment practices which discriminate against or harass any employee or applicant for employment because of race, color, creed, religion, national origin, sex, disability, age, martial status, sexual orientation, or status with regard to public assistance. Such employment practices include, but are not limited to, the following: hiring, upgrading, demotion, transfer, recruitment or recruitment advertising, selection, layoff, disciplinary action, termination, rates of pay or other forms of compensation, and selection for training, including apprenticeship.

Further, Scott County fully supports incorporation of nondiscrimination rules and regulations into contracts and will commit the necessary time and resources to achieve the goals of Equal Employment Opportunity.

Any employee of the County who does not comply with the Equal Employment Opportunity Policies and Procedures set forth in this Statement and Plan will be subject to disciplinary action. Any subcontractor of the County not complying with all applicable Equal Employment Opportunity laws, directives, and regulations of Federal, State, and local governing bodies or agencies thereof, including Minnesota Statutes, Chapter 363A, will be subject to appropriate contractual sanctions.

Scott County has designated the Employee Relations Director as the manager of the Equal Opportunity Program. These responsibilities will include monitoring all Equal Employment Opportunity activities and reporting the effectiveness of this program, as required by Federal, State, and local agencies. The Scott County Administrator will receive and review reports on the progress of the program. If any employee or applicant for employment believes he or she has been discriminated against, please contact the Scott County Employee Relations Director, Scott County Employee Relations, Government Center Room 201, 200 Fourth Avenue West, Shakopee, Minnesota 55379-1220, or call (952) 496-8103.

1-8-19

Lezlie A. Vermillion — Date
Scott County Administrator

Barb Weckman Brekke 1-8-19

Barb Weckman Brekke — Date
Chair, Board of Commissioners

DOCUMENT 00 72 00 - GENERAL CONDITIONS

The General Conditions of the Contract for Construction shall be AIA Document A201 – 2007 which is hereby made a part of this Project Manual, and follows this section.

END OF DOCUMENT 00 72 00

(Page left blank intentionally)

DOCUMENT 00 73 00 - SUPPLEMENT TO GENERAL CONDITIONS

THIS DOCUMENT SETS FORTH THE AMENDMENTS AND MODIFICATIONS TO THE GENERAL CONDITIONS OF THE CONTRACT FOR CONSTRUCTION (AIA DOCUMENT A201-2007) WHICH ARE HEREBY INCORPORATED BY REFERENCE. THE TERMS AND CONDITIONS SET FORTH HEREIN ARE BINDING ON THE PARTIES. DOCUMENT A201-2007 REMAINS IN FULL FORCE AND EFFECT, EXCEPT AS SPECIFICALLY MODIFIED HEREIN. IN CASE OF CONFLICT BETWEEN GENERAL CONDITIONS AND THIS SUPPLEMENT, THE SUPPLEMENT TO GENERAL CONDITIONS SHALL GOVERN.

ARTICLE 1 – GENERAL PROVISIONS

§ 1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

Add the following new § 1.2.4:

§ 1.2.4 In the event of conflicts or discrepancies among the Contract Documents, interpretations will be based on the following priorities:

1) The Agreement.
2) Addenda, with those of later date having precedence over those of earlier date.
3) The Supplementary Conditions.
4) The General Conditions of the Contract for Construction.
5) Drawings and Specifications.

Add the following new § 1.2.4.1:

§ 1.2.4.1 In the case of an inconsistency between Drawings and Specifications or within either Document not clarified by addendum, the better quality or greater quantity of Work shall be provided.

Add the following new § 1.2.4.2:

§ 1.2.4.2 In the case of an inconsistency between Reference Standards and Specifications, the Specifications will have precedence.

§ 1.5 OWNERSHIP AND USE OF DRAWINGS, SPECIFICATIONS, AND OTHER INSTRUMENTS OF SERVICES

Add the following text to § 1.5.1, at end of the first sentence:

§ 1.5.1 …except as otherwise agreed in writing.

ARTICLE 2 – OWNER

§ 2.1 GENERAL

Delete § 2.1.2

§ 2.2 INFORMATION AND SERVICES REQUIRED OF THE OWNER

Delete § 2.2.1

Delete § 2.2.3 and substitute the following:

§ 2.2.3 The Owner may furnish surveys describing physical characteristics, legal limitations and utility locations for the site of the Project, and a legal description of the site. The Contractor shall be entitled to rely on the accuracy of information furnished by the Owner but shall exercise proper precautions relating to the safe performance of the Work.

ARTICLE 3 – CONTRACTOR

§ 3.2 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS BY CONTRACTOR

Delete § 3.2.2 and substitute the following:

§ 3.2.2 Because the Contract Documents are complementary, the Contractor shall before starting each portion of the Work, carefully study and compare the various Contract Documents relative to that portion of the Work, as well as the information furnished by the Owner pursuant to Section 2.2.3, shall take field measurements of any existing conditions related to that portion of the Work, and shall observe any condition at the site affecting it. The Contractor shall promptly report to the Architect any errors, inconsistencies or omissions discovered by or made known to the Contractor as a request for information in such form as the Architect may require. It is recognized that the Contractor's review is made in the Contractor's capacity as a Contractor and not as a licensed design professional unless otherwise specifically provided in the Contract Documents.

Delete § 3.2.4 and substitute the following:

§ 3.2.4 If the Contractor believes that additional cost or time is involved because of clarifications or instructions the Architect issues in response to the Contractor's notices or requests for information pursuant to Section 3.2.2 and 3.2.3, the Contractor shall make Claims as provided in Article 15. If the Contractor fails to perform the obligations of Section 3.2.2 and 3.2.3, the Contractor shall pay such costs and damages to the Owner as would have been avoided if the Contractor had performed such obligations. If the Contractor performs those obligations, the Contractor shall not be liable to the Owner or Architect for damages resulting from errors, inconsistencies or omissions in the Contract Documents that could not have been discovered by a prudent and experienced contractor in advance and that are not of the nature of items described in and intended to be covered in Section 1.2.1 and 3.2.1, or for differences between field measurements or conditions and the Contract Documents unless the Contractor recognized or reasonably should have recognized such error, inconsistency, omission or difference and failed to report it to the Architect, or for nonconformities of the Contract Documents to applicable laws, statutes, ordinances, codes, rules and regulations, and lawful orders of public authorities.

Add the following new § 3.2.4.1:

§ 3.2.4.1 If any errors, inconsistencies or omissions in Contract Documents are recognized or reasonably should have been recognized by the Contractor, any member of its organization, or any of its Subcontractors, the Contractor shall be responsible for notifying the Architect in writing of such error, inconsistency or omission before proceeding with the Work. The Architect will take such notice under advisement and within a reasonable time commensurate with job progress render a decision. The Architect's decision shall be subject to Owner's approval. If Contractor

fails to give such notice and proceeds with such Work, it shall correct any such errors, inconsistencies or omissions at no additional cost to the Owner.

Add the following new § 3.2.5:

§ 3.2.5: Should the Specifications and Drawings fail to describe particularly the material or kind of goods to be used in any place, then it shall be the duty of the Contractor to make inquiry of the Owner and Architect as to what is of the highest grade and best-suited. The material that would normally be used in this place to produce first quality finished Work shall be considered a part of the Contract.

Add the following new § 3.2.6

§ 3.2.6 On all Project Drawings, figures take precedence over measurements by scale, and any scaling is done at the Contractor's own risk. Should any Project Drawings or figures have been omitted which are necessary to a clear understating of the Work or should any error appear in either, or discrepancies between the Project Drawings and Project Specifications, it shall be the duty of the Contractor to notify the Architect of such omission, errors, or discrepancies, and in no case proceed in uncertainty, should any mistake arise in consequences of such neglect on the part of the Contractor to notify the Architect, he must correct them at his own expense.

Add the following new § 3.2.7:

§ 3.2.7 Before ordering any material or doing any work, the Contractor shall verify all measurements at the project Site for his work and he shall be responsible for the correctness of same. No extra charge of compensation will be allowed to the Contractor on account of differences between actual dimensions and the measurements shown by the Project Drawings.

Add the following new § 3.2.8:

§ 3.2.8 The Contractor covenants that they presently have no interest and shall not acquire any interest, direct, or indirect, which would conflict in any manner or degree with the performance of services required to be performed under this Contract. The Contractor further covenants that in the performance of this Contract no person having such an interest shall be employed by the Contractor hereunder.

§ 3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

Add the following new § 3.3.4

§ 3.3.4 It is understood and agreed that the relationship of Contractor to Owner shall be that of an independent contractor. Nothing contained herein or inferable wherefrom shall be deemed or construed to (1) make Contractor the agent, servant, or employee of the Owner, or (2) create any partnership, joint venture, or other association between Owner and Contractor. Any direction or instruction by Owner in respect of the Work shall relate to the results the Owner desires to obtain from the Work, and shall in no way affect Contractor's independent contractor status as described herein and Contractor's obligation for all construction means and methods.

Add the following new § 3.3.5

§ 3.3.5 The Contractor has the responsibility to ensure that all material suppliers and Subcontractors, their agents, and employees adhere to the Contract Documents, and that they order materials on time, taking into account the current market and delivery conditions and that they provide materials on time. The Contractor shall coordinate its Work with that of all other on the Project, including deliveries, storage, installations and construction utilities. The Contractor shall be responsible for the space requirements, locations, and routing of its equipment. In areas and location where the proper and more effective space requirements, locations and routing cannot be made as indicated, the Contractor shall meet with all other involved, before installation to plan the most effective and efficient method of overall installation. The Contractor shall have the duty to coordinate all of its work and the work of its Subcontractors and suppliers.

§ 3.4 LABOR AND MATERIALS

Add the following new § 3.4.1.1:

§ 3.4.1.1 Contract Documents may require or Contractor may elect to perform work after regular working hours. Additional cost of such work shall be borne by Contractor.

§ 3.5 WARRANTY

Add the following text to § 3.5:

§ 3.5 In addition to the foregoing stipulations, the Contractor shall comply with all other warranties referred to in any portion of the Contract Documents or otherwise provided by law or in equity, and where warranties overlap, the more stringent requirements shall govern.

§ 3.7 PERMITS, FEES, NOTICES, AND COMPLIANCES WITH LAWS

Delete § 3.7.4 and substitute the following and all of its provisions:

§ 3.7.4 Subsurface and Physical Conditions

§ 3.7.4.1 Reports and Drawings: The Bidding Requirements identify:

.1 those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Architect has used in preparing the Contract Documents; and

.2 those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Architect has used in preparing the Contract Documents.

§ 3.7.4.2 Limited Reliance by Contractor on Technical Data Authorized: Contractor may rely upon the general accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Bidding Requirements. Except for such reliance on such "technical data," Contractor may not rely upon or make any Claim against Owner, Architect, or any of Architect's Consultants with respect to:

.1 the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

.2 other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

.3 any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

§ 3.7.4.3 Differing Subsurface or Physical Conditions

.1 Notice: If Contractor believes that any subsurface or physical condition at or contiguous to the Site that is uncovered or revealed either:

(1) is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Section 3.7.4.2 is materially inaccurate; or

(2) is of such a nature as to require a change in the Contract Documents; or

(3) differs materially from that shown or indicated in the Contract Documents; or

(4) is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Section 10.4), notify Owner and Architect in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

.2 Architect's Review: After receipt of written notice as required by Section 3.7.4.3.1 Architect will promptly review the pertinent condition, determine the necessity of Owner's obtaining additional exploration or tests with respect thereto, and advise Owner in writing (with a copy to Contractor) of Architect's findings and conclusions.

.3 Possible Price and Times Adjustments

(1) The Contract Sum or the Contract Time, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

(a) such condition must meet any one or more of the categories described in Section 3.7.4.3.1; and

(b) with respect to Work that is paid for on a Unit Price Basis, any adjustment in Contract Price will be subject to the provisions of Sections 7.3.3.2 and 7.3.4.

(2) Contractor shall not be entitled to any adjustment in the Contract Sum or Contract Time if:

(a) Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner in respect of Contract Sum and Contract Time by the submission of a Bid or becoming bound under a negotiated contract; or

(b) the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

(c) Contractor failed to give the written notice within the time and as required by Section 3.7.4.3.1.

(3) If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Sum or Contract Times, or both, a Claim may be made therefore as provided in Article 15. However, Owner, Architect, and Architect's Consultants shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connections with any other project or anticipated project.

§ 3.13 USE OF SITE

Add the following new § 3.13.1:

§ 3.13.1 Owner may perform certain other work on site during course of construction with own personnel or by separate Contract. Permit full access to entire site by Owner or other Contractors, coordinate work with theirs, and cooperate in any way possible.

§ 3.18 INDEMNIFICATION

Delete § 3.18.1 and substitute the following:

§ 3.18.1 The Contractor agrees to defend, indemnify, and hold the County, its employees and officials harmless from any claims, demands, actions or causes of action, including reasonable attorney's fees and expenses resulting directly or indirectly from any negligent act or omission on the part of the Contractor, or its subcontractors, partners or independent contractors or any of their agents or employees, in the performance of or with relation to any of the work or services to be performed or furnished by the Contractor or the subcontractors partners or independent contractors or any of their agents or employees under the agreement.

The Contractor shall be responsible for the professional quality, technical accuracy, and the coordination of all services furnished by the Contractor under this agreement. The Contractor shall, without additional compensation, correct or revise any errors or deficiencies in the Contractor's final reports and services in this Section 3.18.

ARTICLE 5 – SUBCONTRACTORS

§ 5.1 DEFINITIONS

Add the following new § 5.1.3:

§ 5.1.3 The Contractor shall be responsible to the Owner for the acts and omissions of all his employees and all Subcontractors, their agents and employees, and all other persons performing any of the Work under a contract with the Contractor. Nothing contained in the Contract Documents shall create any contractual relationship between any Subcontractor and the Owner. It is further understood that the Owner will have no direct relations with any Subcontractor. Any necessary relations between the Owner and a Subcontractor shall be handled by the Contractor.

§ 5.2 AWARD OF SUBCONTRACTS AND OTHER CONTRACTS FOR PORTIONS OF THE WORK

Delete § 5.2.1 and substitute the following:

§ 5.2.1 Unless otherwise stated in the Contract Documents or the bidding requirements, the Contractor, as soon as practicable after notification of award of the Contract, shall furnish in writing to the Owner through the Architect the names of persons or entities (including those who are to furnish materials or equipment fabricated to a special design) purposed for each principal portion of the Work. The Architect may reply within 14 days to the Contractor in writing stating (1) whether the Owner or the Architect has objection to any such proposed person or entity or (2) that the Architect requires additional time for review. Failure of the Owner or Architect to reply within the 14-day period shall constitute notice of no objection.

Delete § 5.2.3 and substitute the following:

§ 5.2.3 If the Owner or Architect has objections to a person or entity proposed by the Contractor, the Contractor shall propose another to whom the Owner or Architect has no objection. If the proposed but rejected Subcontractor was reasonably capable of performing the Work, the Contract Sum and Contract Time shall be increased or decreased by the difference, if any occasioned by such change, and an appropriate Change Order shall be issued before commencement of the substitute Subcontractors' Work. However, no increase in the Contract Sum or Contract Time shall be allowed for such change unless the Contractor has acted promptly and responsively in submitting names as required.

§ 5.3 SUBCONTRACTUAL RELATIONS

Delete § 5.3 and substitute the following:

§ 5.3 By written agreement the Contractor shall require each Subcontractor, to the extent of the Work to be performed by the Subcontractor, to be bound to the Contract by terms of the Contract Documents, and to assume toward the Contractor all the obligations and responsibilities, including the responsibility for safety of the Subcontractor's Work, which the Contractor, by these Documents, assumes toward the Owner and Architect. Each subcontract agreement shall preserve and protect the rights of the Owner and Architect under the Contract Documents with respect to the Work to be performed by the Subcontractor so that subcontracting thereof will not prejudice such rights, and shall allow to the Subcontractor, unless specifically provided otherwise in the subcontract agreement, the benefit of all rights, remedies and redress against the Contractor that the Contractor, by the Contract Documents, has against the Owner. Where appropriate, the contractor shall require each Subcontractor to enter into similar agreements with Sub-subcontractors. The Contractor shall make available to the Owner and to each proposed Subcontractor, prior to the execution of the subcontract agreement, copies of the Contract Documents to which the Subcontractor will be bound, and, identify to the Owner and the Subcontractor terms and conditions of the proposed subcontract agreement that may be at variance with the Contract Documents. Subcontractors will similarly make copies of applicable portions of such documents available to their respective proposed Sub-subcontractors.

ARTICLE 6 – CONSTRUCTION BY OWNER OR BY SEPARATE CONTRACTORS

§ 6.2 MUTUAL RESPONSIBILITY

Delete § 6.2.4 and substitute the following:

§ 6.2.4 The Contractor shall promptly remedy damage the Contractor causes to completed or partially completed construction or to property of the Owner or separate contractors as provided in Section 10.2.5.

ARTICLE 7 – CHANGES IN THE WORK

§ 7.2 CHANGE ORDERS

Add the following new § 7.2.2:

§ 7.2.2 Change order amounts are understood to include costs plus amount for overhead and profit agreed upon under Section 7.3.7 and required adjustments to Contract Time. No further consideration for additional impact upon Contract Sum or Contract Time will be made as result of any change order or as cumulative result of any or all change orders as may be agreed to by Owner and Contractor.

§ 7.3 CONSTRUCTION CHANGE DIRECTIVES

Delete § 7.3.7 and substitute the following:

§ 7.3.7 If the Contractor does not respond promptly or disagrees with the method for adjustment in the Contract Sum, the Architect shall determine the method and the adjustment on the basis of reasonable expenditures and savings of those performing the Work attributable to the change, including, in case of an increase in the Contract Sum, an amount for overhead and profit not to exceed ten percent (10%) of the net cost of Work accomplished by the Contractor's own forces, or five percent (5%) of the net cost of Work accomplished by Subcontractors. Subcontractors and subsequent tiers of Contractors may add the same allowance. In such case, and also under Section 7.3.3.3, the Contractor shall keep and present, in such form as the Architect may prescribe, an itemized accounting together with appropriate supporting data. Unless otherwise provided in the Contract Documents, costs for the purposes of this Section 7.3.7 shall be limited to the following:

.1 costs of labor, including social security, old age and unemployment insurance, fringe benefits required by agreement or custom, and workers' compensation insurance;

.2 costs of materials, supplies and equipment, including cost of transportation, whether incorporated or consumed;

.3 reasonable rental costs of machinery and equipment, exclusive of hand tools, whether rented from the Contractor or others directly attributable to the Work; and

.4 costs and premiums for all bonds and insurance, permit fees, and sales, use or similar taxes directly attributed to the Work.

ARTICLE 8 – TIME

§ 8.3 DELAYS AND EXTENSIONS OF TIME

Delete § 8.3.1 and substitute the following:

§ 8.3.1 Extension of time provided for the completion of the Work shall be the Contractor's sole remedy for delay (except for the Contractor's right to terminate the Contract pursuant to the provisions of Article 14 hereof), unless the same shall have been caused by acts constituting intentional interference by Owner with Contractor's performance of the Work and where to the extent that such acts of the Owner continue after Contractor's notice to Owner of such interference. The Owner's exercise of any of its rights under the Contract, including, without limitation, its rights under Article 7, regardless of the extent or number of such Changes, or the Owner's exercise of any of its remedies or suspension of the Work, extent or number of such Changes, or the Owner's exercise of any of its remedies or suspension of the Work, or requirement of correction or re-execution of any defective Work, shall not under any circumstances be construed as intentional interference with Contractor's performance of the Work.

ARTICLE 9 – PAYMENTS AND COMPLETION

§ 9.3 APPLICATIONS FOR PAYMENT

Delete § 9.3.1 and substitute the following:

§ 9.3.1 At least ten days before the date established for each progress payment, the Contractor shall submit to the Architect an itemized Application for Payment prepared in accordance with the schedule of values, if required under Section 9.2, for completed portions of work. Such application shall be notarized, if required, and supported by such data substantiating the Contractor's right to payment as the Owner or Architect may require, such as copies of requisitions from Subcontractors and material suppliers, and shall reflect retainage if provided for in the Contract Documents. Any allowances included in the Application for Payment shall be separately itemized with supporting data attached. The Application for Payment shall be accompanied by a certification by an officer of Contractor to the effect that: There are no claims, legal or equitable, contractual, statutory, or constitutional, outstanding or known to exist at the date of this Application; all due and payable bills with respect to the Work have been paid to date or are included in the amount requested in the current Application and there is no known basis for which a party would have the right (if this were a privately owned project) to file a mechanics', materialmen's or laborers' lien or claim or any other lien or claim, legal or equitable, constructual, statutory, or constitutional, on the Work. In addition all applications for payment shall contain the payroll information required by Document 00 7343 – Labor and Wage Rate Requirements.

Delete § 9.3.1.2 and substitute the following:

§ 9.3.1.2 Applications for the payment shall not include requests for payment for portions of the Work for which the Contractor does not intend to pay Subcontractor or material supplier because of a dispute or other reason.

§ 9.6 PROGRESS PAYMENTS

Delete § 9.6.1 and substitute the following:

§ 9.6.1 After the Architect has issued a Certificate for Payment, the Owner shall make payment in the manner and within the time provided in the Contract Documents, and shall so notify the Architect. The Owner may refuse to make payment on any Certificate for Payment for any default of the Contract, including, but not limited to those defaults set forth in Section 9.5.1.1 through 9.5.1.7. The Owner shall not be deemed in default by reason of withholding payment while any of such defaults remain uncured. A total of five percent (5%) of each approved partial payment shall be retained until completion and final acceptance of the Work.

§ 9.8 SUBSTANTIAL COMPLETION

Delete § 9.8.1 and substitute the following:

§ 9.8.1 Substantial Completion is the stage in the progress of the Work when the Work or designated portion thereof is sufficiently complete in accordance with the Contract Documents so that the Owner can occupy or utilize the Work for its intended use. The Work will not be considered suitable for Substantial Completion review until all Project systems included in the Work are operational as designed and scheduled, all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in the operation of system has been completed, and all final finishes within the Contract are in place. In general, the only remaining Work shall be minor in nature, so that the Owner or Owner's tenants could occupy the building or other improvements on that date and the completion of the Work by the Contractor would not materially interfere or hamper the Owner's or Owner's tenants' (or those claiming by, through or under Owner) normal business operations. As a further condition of Substantial Completion acceptance, the Contractor shall certify that all remaining Work will be completed within thirty (30) consecutive calendar days or as agreed upon following the Date of Substantial Completion. The Contractor will be assessed a daily charge, on a calendar day basis, in the amount of five hundred and no/100 dollars ($500.00) per day for each day the Contractor has failed to achieve substantial completion beyond the date for substantial completion specified in the Agreement, unless a different sum for per diem liquidated damages is specified in the Special Conditions of the Contract.

Add the following new § 9.8.3.1:

§ 9.8.3.1 If, after such measures are taken, subsequent inspections by the Architect reveal that any of the previously identified particulars remain incomplete or defective, the Architect will again notify the Contractor in writing of the remaining particulars. All costs associated with any subsequent inspections in which said remaining particulars are revealed, will be documented by the Architect and paid by the Contractor to the Owner.

§ 9.9 PARTIAL OCCUPANCY OR USE

Add the following new § 9.9.2.1:

§ 9.9.2.1 After occupancy, Owner will allow Contractor reasonable access to occupied area to complete and correct work.

Add the following new § 9.9.3.1

§ 9.9.3.1 Use or occupancy by Owner shall not be deemed to constitute waiver of existing claims on behalf of Owner or Contractor against each other.

Add the following new § 9.9.4

§ 9.9.4 Owner shall have the right, if exercised reasonably and without substantial disruption to Contractor, to install furnishings and equipment within project prior to substantial completion of work. Such installation shall not constitute occupancy or use by Owner.

§ 9.10 FINAL COMPLETTION AND FINAL PAYMENT

Delete § 9.10.2 and substitute the following:

§ 9.10.2 Neither final payment nor any remaining retained percentage shall become due until the Contractor submits to the Architect (1) an affidavit that payrolls, bills for materials and equipment, and other indebtedness connected with the Work for which the Owner or the Owner's property might be responsible or encumbered (less amounts withheld by Owner) have been paid or otherwise satisfied, (2) a certificate evidencing that insurance required by the Contract Documents to remain in force after final payment is currently in effect, (3) a written statement that the Contractor knows of no substantial reason that the insurance will not be renewable to cover the period required by the Contract Documents, (4) consent of surety, if any, to final payment and (5), if required by the Owner, other data establishing payment or satisfaction of obligations, such as receipts, releases and waivers of liens, claims, security interests or encumbrances arising out of the Contract, to the extent and in such form as may be designated by the Owner. If a Subcontractor refuses to furnish a release or waiver required by the Owner, the Contractor may furnish a bond satisfactory to the Owner to indemnify the Owner against such lien. If such lien remains unsatisfied after payments are made, the Contractor shall refund to the Owner all money that the Owner may be compelled to pay in discharging such lien, including all costs and reasonable attorneys' fees.

ARTICLE 10 – PROTECTION OF PERSONS AND PROPERTY

§ 10.2 SAFETY OF PERSONS AND PROPERTY

Delete § 10.2.2 and substitute the following:

§ 10.2.2 The Contractor shall comply with and give notices required by applicable laws, statutes, ordinances, codes, rules, and regulations, and lawful orders of public authorities bearing on safety of persons or property or their protection from damage, injury or loss. The Contractor shall provide all facilities and shall follow all regulations and procedures required by the Occupational Safety and Health Act (OSHA) including, but not limited to providing and posting all required posters and notices and shall otherwise be responsible for all other mandatory safety laws.

ARTICLE 11 – INSURANCE AND BONDS

§ 11.1 CONTRACTOR'S LIABILITY INSURANCE

Delete § 11.1.1 and substitute the following:

§ 11.1.1 The Contractor shall purchase from and maintain in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located such insurance as will protect the Contractor, and is reasonably acceptable to Owner, from claims set forth below which may arise out of or results from the Contractor's operations and completed operations under the Contract and for which the Contractor may be legally liable, whether such operations be by the Contractor or by a Subcontractor or by anyone directly or indirectly employed by any of them, or by anyone for whose acts any of them may be liable:

.1 claims under workers' compensation, disability benefit and other similar employee benefit acts which are applicable to the Work to be performed;

.2 claims for damages because of bodily injury, occupational sickness or disease, or death of the Contractor's employees;

.3 claims for damages because of bodily injury, sickness or disease, or death of any person other than the Contractor's employees;

.4 claims for damages insured by usual personal injury liability coverage;

.5 claims for damages, other than to the Work itself, because of injury to or destruction of tangible property, including loss of use resulting therefrom;

.6 claims for damages because of bodily injury, death of a person or property damage arising out of ownership, maintenance or use of a motor vehicle;

.7 claims for bodily injury or property damage arising out of completed operations; and

.8 claims involving contractual liability insurance applicable to the Contractor's obligations under Section 3.18.

Add the following new § 11.1.2.1:

§11.1.2.1 Worker's Compensation

1) State: Minnesota – Statutory
2) Employer's Liability with minimum limits of:
   Bodily Injury by Accident: $100,000 each Accident
   Bodily Injury by Disease:$100,000 each Employee
   Bodily Injury by Disease:$500,000 policy limit
3) Benefits required by union labor contracts: as applicable

In the event the Contractor is a sole proprietor and has not elected to provide workers' compensation insurance, the Contractor shall be required to execute and submit an affidavit of sole proprietorship in a form satisfactory to Scott County before entering into the agreement.

Add the following new § 11.1.2.2:

§11.1.2.2 Commercial General Liability

Including Premises, Operations, Products, Completed Operations, Advertising, and Personal Injury Liability, with the following minimum limits of liability:

$2,000,000	Aggregate
$2,000,000	Products & Completed Operations Aggregate
$1,000,000	Personal Injury & Advertising Injury
$1,000,000	Occurrence
$ 100,000	Fire Damage Limit
$ 5,000	Medical Expense

Policy should be written on an occurrence basis and include explosion, collapse and underground.

Add the following new § 11.1.2.3:

§ 11.1.2.3 Commercial Auto Liability

Automobile Liability should include Hired and Non-Owned, and the County should be named as an additional insured.

Minimum limits of liability shall be:

If split limits: $1,000,000 each person/$1,000,000 each occurrence for Bodily Injury
$1,000,000 each occurrence for Property Damage

If combined single limit: $1,000,000 per occurrence

Delete § 11.1.3 and substitute the following:

§ 11.1.3 Insurance certificates evidencing that the above insurance is in force with companies acceptable to County and in the amounts required shall be submitted to County for examination and approval prior to the execution of the agreement, after which they shall be filed with County. **The insurance certificate shall name the County as an additional insured and specifically provide that a certificate shall not be materially changed, canceled or non-**

renewed except upon sixty (60) days prior written notice to County. Neither County's failure to require or insist upon certificates, nor other evidence of a variance from the specified coverage requirements, amends Contractor's responsibility to comply with the insurance specifications.

§ 11.3 PROPERTY INSURANCE

Delete § 11.3.1 and substitute the following:

11.3.1 The Contractor shall purchase and maintain, in a company or companies lawfully authorized to do business in the jurisdiction in which the Project is located, property insurance upon the entire Work at the site. The insurance required by this Section 11.3 shall be written in an amount no less than the total of the initial Contract Sum, plus value of subsequent Contract modifications and cost of materials supplied or installed by others, comprising total value for the entire Project at the site on a replacement cost basis without optional deductibles. The insurance required by this Section 11.3 shall be written on builder's risk completed value basis and shall be the "All Physical Loss" type. Property insurance shall be continuous, and the property insurance required by this Section 11.3 shall not be permitted to lapse until the Owner has purchased permanent property insurance on the Project. The Owner will assume responsibility of all property insurance costs on the date of its occupancy or the date of substantial completion of the Project whichever is sooner. The insurance shall include interest of the Owner, the Contractor, Subcontractor and Sub-subcontractors in the Project.

Delete § 11.3.1.2 and substitute the following:

§ 11.3.1.2 NOT USED

Delete § 11.3.1.3 and substitute the following:

11.3.1.3 If the property insurance requires deductibles, the Contractor shall pay costs not covered because of such deductibles.

Delete § 11.3.6 and substitute the following:

§11.3.6 Before an exposure to loss may occur, the Contractor shall file with the Owner a copy of each policy that includes insurance coverages required by this Section 11.3. Each policy shall contain all generally applicable conditions, definitions, exclusions and endorsements related to this Project. The Contractor shall provide written notification to the Owner of the cancellation or expiration of any insurance required by Section 11.2 and 11.3. The Contractor shall provide such written notice within five (5) business days of the date the Contractor is first aware of the cancellation or expiration, or is first aware that the cancellation or expiration is threatened or otherwise may occur, whichever comes first.

Delete § 11.3.7 and substitute the following:

11.3.7 Waivers of Subrogation. The Owner and Contractor waive all rights against (1) each other and any of their Subcontractors, Sub-subcontractors, agents and employees, each of the other, and (2) the Architect, Architect's consultants, separate contractors described in Article 6, if any, and any of their subcontractors, sub-subcontractors, agents and employees, for damages caused by fire or other causes of loss to the extent covered by property insurance obtained pursuant to this Section 11.3 or other property insurance applicable to the Work, except such rights as they have to proceeds of such insurance held by the Contractor as fiduciary. The Owner or Contractor, as appropriate, shall require of the Architect, Architect's consultants, separate contractors described in Article 6 if any, and the subcontractors, sub-subcontractors, agents and employees of any of them, by appropriate agreements, written where legally required for validity, similar waivers each in favor of other parties enumerated herein. The policies shall provide such waivers of subrogation by endorsement or otherwise. A waiver of subrogation shall be effective as to a person or entity even though that person or entity would otherwise have a duty of indemnification, contractual or otherwise, did not pay the insurance premium directly or indirectly, and whether or not the person or entity had an insurable interest in the property damaged.

Delete § 11.3.8 and substitute the following:

11.3.8 A loss insured under Contractor's property insurance shall be adjusted by the Contractor as fiduciary and made payable to the Contractor as fiduciary for the insureds, as their interests may appear, and of Section 11.3.10. The Contractor shall pay Subcontractors their just shares of insurance proceeds received by the Contractor, and by appropriate agreements, written where legally required for validity, shall require Subcontractors to make payments to their Sub-subcontractors in similar manner.

Delete § 11.3.9 and substitute the following:

11.3.9 If required in writing by a party in interest, the Contractor as fiduciary shall, upon occurrence of an insured loss, give bond for proper performance of the Contractor's duties. The cost of required bonds shall be charged against proceeds received as fiduciary. The Contractor shall deposit in a separate account proceeds so received, which the Contractor shall distribute in accordance with such agreement as the parties in interest may reach, or as determined in accordance with the method of binding dispute resolution selected in the agreement between the Owner and the Contractor. If after such loss no other special agreement is made and unless the Owner terminates the Contract for convenience, replacement of damaged property shall be performed by the Contractor after notification of a change in the Work in accordance with Article 7.

Delete § 11.3.10 and substitute the following:

11.3.10 The Contractor's fiduciary shall have power to adjust and settle a loss with insurers unless one of the parties in interest shall object in writing within five days after occurrence of loss to the Contractor's exercise of this power; if such objection is made, the dispute shall be resolved in the manner selected by the Owner and the Contractor as the method of binding dispute resolution in the agreement. If the Owner and the Contractor have selected arbitration as the method of binding dispute resolution, the Contractor's fiduciary shall make settlement with insurers or, in the case of a dispute over distribution of insurance proceeds in accordance with the directions of the arbitrators.

ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

§ 12.1 UNCOVERING THE WORK

Delete § 12.1.1 and substitute the following:

§ 12.1.1 If a portion of the Work is covered contrary to the Architect's request or to requirements specifically expressed in the Contract Documents, it must, if requested in writing by the Architect, be uncovered for the Architect's examination and be replaced at the Contractor's expense without change in the Contract Time or Contract Sum.

§ 12.2 CORRECTION OF WORK

Delete § 12.2.2.1 and substitute the following:

§ 12.2.2.1 In addition to the Contractor's obligations under Section 3.5, if, within one year after the date of Substantial Completion of the entire Work (unless otherwise provided in any Certificate of Partial Substantial Completion approved by the parties,) or within such longer period of time as may be prescribed by law or in equity, or by terms of an applicable special warranty required by the Contract Documents, any of the Work is found to be not in accordance with the requirements of the Contract Documents, the Contractor shall correct it promptly after receipt of written notice from the Owner to do so unless the Owner has previously given the Contractor a written acceptance of such condition. This corrective period shall be extended with respect to portions of Work first performed after Substantial Completion by the period of time between substantial Completion and the actual performance of the Work. Corrective Work shall be warranted to be free from defects for a period equal to the longer of six (6) months after the completion of the corrective Work or one (1) year after the Date of Substantial Completion (subject to extension as previously described) or such longer period of time as may be prescribed by law or in equity, or expiration of the term of any applicable special warranty, if applicable, required by the Contract Documents. Any defect in such Work shall be corrected again by Contractor promptly upon notice from the Owner

of the defect. This obligation under this Section shall be corrected again by Contractor promptly upon notice of the defect from the Owner. This obligation under this Section 12.2.2.1 shall survive acceptance of the Work under that Contract and termination of the Contract. The Owner shall give such notice promptly after discovery of the condition by the Owner. During the one-year period for correction of Work, if the Owner fails to notify the Contractor and give the Contractor an opportunity to make the correction, the Owner waives the rights to require correction by the Contractor and to make a claim for breach of warranty. If the Contractor fails to correct nonconforming Work within a reasonable time during that period after receipt of notice from the Owner or Architect, the Owner may correct it in accordance with Section 2.4.

Delete § 12.2.2.3

ARTICLE 13 – MISCELLANEOUS PROVISIONS

§ 13.7 TIME LIMITS ON CLAIMS

Delete § 13.7 and substitute the following:

§ 13.7 The Owner and Contractor shall commence any legal action against the other seeking damages within four (4) years from the date the damages become known or, in the case of claims for contribution or indemnification, within four (4) years of the entry of judgment or payment of settlement giving rise to the claim. The Owner and Contractor hereby agree to waive all other statutes of limitation and repose.

ARTICLE 14 – TERMINATION OR SUSPENSION OF THE CONTRACT

§ 14.1 TERMINATION BY THE CONTRACTOR

Delete § 14.1.3 and substitute the following:

§ 14.1.3 If one of the reasons described in Section 14.1.1 or 14.1.2 exists, the Contractor may, upon fourteen day's written notice to the Owner and Architect, unless this reason is cured prior to the expiration of the notice, terminate the Contract period and recover from the Owner payment for Work executed, including reasonable overhead and profit, costs incurred by reason of such termination, and damages.

§ 14.2 TERMINATION BY OWNER FOR CAUSE

Delete § 14.2.1 and substitute the following:

§14.2.1 The Owner may terminate the Contract if the Contractor:

.1 refuses or fails to supply enough properly skilled workers or proper materials or equipment; or

.2 fails to make payment to Subcontractors for materials or equipment or labor in accordance with the respective agreements between the Contractor and Subcontractors; or

.3 disregards applicable laws, statutes, ordinances, codes, rules and regulations or lawful orders of a public authority; or

.4 otherwise is guilty of breach of a provision of the Contract Documents; or

.5 is adjudged as bankrupt or insolvent, or makes a general assignment for the benefit of Contractor's creditors, or a trustee or receiver is appointed for Contractor or for any of its property, or files a petition to take advantage of any debtor's act, or to reorganize under bankruptcy or similar laws.

Delete § 14.2.4 and substitute the following:

§ 14.2.4 If the unpaid balance of the Contract Sum exceeds costs of finishing the Work, including compensation for the Architect's services and any other professional services and expenses made necessary thereby, and other damages incurred by the Owner and not expressly waived, such excess shall be paid to the Contractor. If such costs and damages exceed the unpaid balance, the Contractor shall pay the difference to the Owner. The amount to be paid to the Contractor or Owner, as the case may be, shall be certified by the Initial Decision Maker, upon application, and this obligation for payment shall survive termination of the Contract.

§ 14.4 TERMINATION BY THE OWNER FOR CONVENIENCE

Delete § 14.4.3 and substitute the following:

§ 14.4.3 In case of such termination for the Owner's convenience, the Contractor shall be entitled to receive payment for Work executed, but not to include overhead and profit on the Work not executed.

ARTICLE 15 – CLAIMS AND DISPUTES

§ 15.1 CLAIMS

Delete § 15.1.2 and substitute the following:

§ 15.1.2 Notice of Claims. Claims by either Owner or Contractor must be initiated by written notice to the other party and to the Initial Decision Maker with a copy sent to the Architect, if the Architect is not serving as the Initial Decision Maker. Claims by either party must be initiated within 30 days after occurrence of the event giving rise to such Claim or within 30 days after the claimant first recognizes the condition giving rise to the Claim, whichever is later, provided however that any Claim for an extension of time to complete the Contract shall be made within 10 days after the Contractor recognizes the condition giving rise to the Claim.

§ 15.2 INITIAL DECISION

Delete 15.2.1 and substitute the following:

§ 15.2.1 Claims, excluding those arising under Sections 10.3, 1.4, 11.3.9, and 11.3.10, shall be referred to the Initial Decision Maker for initial decision. The Architect will serve as the Initial Decision Maker, unless otherwise indicated in the Agreement. Except for those Claims excluded by this Section 15.2.1, an initial decision shall be required as a condition precedent to mediation or litigation of any Claim arising prior to the date final payment is due, unless 30 days have passed after the Claim has been referred to the Initial Decision Maker with no decision having been rendered. Unless the Initial Decision Maker and all affected parties agree, the Initial Decision Maker will not decide disputes between the Contractor and persons or entities other than the Owner.

Delete § 15.2.5 and substitute the following:

§ 15.2.5 The Initial Decision Maker will render an initial decision approving or rejecting the Claim, or indicating that the Initial Decision Maker is unable to resolve the Claim. This initial decision shall (1) be in writing; (2) state the reasons therefor; and (3) notify the parties and the Architect, if the Architect is not serving as the Initial Decision Maker, of any change in the Contract Sum or Contract Time or both. The initial decision shall be final and binding on the parties but subject to mediation and/or litigation.

§ 15.3 MEDIATION

Delete § 15.3.1 and substitute the following:

§ 15.3.1 Claims, disputes, or other matters in controversy arising out of or related to the Contract except those waived as provided for in Sections 9.10.4, 9.10.5, and 15.1.6 may be subject to mediation as a condition precedent to litigation upon the written agreement of Contractor and Owner at the time of the initial decision.

Add the following new § 15.3.1.1:

§ 15.3.1.1 Mediation. There shall be no mandatory mediation of claims arising out of or related to the Contract and all language contained in the General Conditions providing for mandatory mediation is superseded by this Section. If the parties mutually agree to mediation, the procedures contained in Section 15.3.1 of the General Conditions shall apply.

Delete § 15.3.2 and substitute the following:

§ 15.3.2 If the parties endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be administered by the American Arbitration Association in accordance with its Construction Industry Mediation Procedures in effect on the date of the Agreement. A request for mediation shall be made in writhing, delivered to the other party to the Contract, and filed with the person or entity administering the mediation. The request may be made concurrently with the filing of binding dispute resolution proceedings but, in such event, mediation shall proceed in advance of binding dispute resolution proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or court order. If an arbitration is stayed pursuant to this Section 15.3.2, the parties may nonetheless proceed to the selection of the arbitrator(s) and agree upon a schedule for later proceedings.

§ 15.4 ARBITRATION

Add the following new § 15.4.1.1:

§ 15.4.1.1 Arbitration. There shall be no mandatory arbitration of claims arising out of or related to the Contract and all language contained in the General Conditions providing for mandatory and/or binding arbitration is superseded by this Section. If the parties mutually agree to non-binding arbitration, the procedures contained in Section 15.4.1 of the General Conditions shall apply but in no case shall any decision be reached.

END OF DOCUMENT 00 73 00

SECTION 00 73 13- SPECIAL CONDITIONS

1. TIME FOR PERFORMANCE

The Contractor agrees to commence said work as herein provided at the earliest practicable date and in any event not later than September 3, 2019 and to prosecute the same diligently and without delay, and substantially complete this work no later than May 31, 2020. [and] the Work shall be finally complete on or before June 15, 2020.

2. ASSESSMENT OF LIQUIDATED DAMAGES

Time is of the essence on this contract.

The Contractor's failure to achieve substantial completion of the work for each project phase will cause the owner to incur damages and losses of types and in amounts which are not possible to determine with certainty.

The Contractor will be assessed a daily charge, on a calendar day basis, for each day the Contractor has failed to achieve substantial completion beyond the date for substantial completion specified in the Agreement. The daily charge will be based on the original contract value, and will be in the amount shown in the Schedule of Liquidated Damages for that value.

SCHEDULE OF LIQUIDATED DAMAGES	
Original Contract Amount From More Than To And Including	Charge Per Calendar Day
$0 - $25,000	$300
$25,000 - $100,000	$400
$100,000 - $500,000	$900
$500,000 - $1,000,000	$1,200
$1,000,000 - $2,000,000	$1,500
$2,000,000 - $5,000,000	$2,500
$5,000,000 - $10,000,000	$3,000
More than $10,000,000	$3,500

3. WAIVER OF LIQUIDATED DAMAGES

A. The Owner may waive all or any portion of the liquidated damage assessment after the date the work is substantially completed and is: (a) in condition for safe and convenient use by the public; or (b) available for next-stage construction without restriction.

B. No liquidated damages will accrue during periods of authorized suspension of all controlling operations.

C. Permitting the Contractor to continue and finish the work or any part of it after the time fixed for its completion shall not in any way operate as a waiver on the part of the Owner or any of its rights under the Contract. Neither by the act of taking over the work nor by annulment of the Contract shall the Owner forfeit the right to recover liquidated damages from the Contractor or his sureties.

4. CONTRACTOR'S BONDS

A. The Contractor shall furnish the Owner with satisfactory evidence within fifteen (15) days following notification of award of contract that the Contract can be faithfully performed and that all obligations arising under the contract can be paid.

1. For projects with a Total Base Bid cost of completing the Work of less than $5,000, two forms of satisfactory evidence are required. Satisfactory evidence is defined as:

   a. Cashiers check; or
   b. Certified check.

2. For projects with a Total Base Bid cost of completing the Work of $5,000 or greater but less than or equal to $50,000, two forms of satisfactory evidence are required. Satisfactory evidence is defined as:

   a. Performance Bond and Labor and Material Payment Bond; or
   b. Irrevocable bank letter of credit and Labor and Material Payment Bond.

3. For projects with a Total Base Bid cost of completing the Work of greater than $50,000, two forms of satisfactory evidence are required. Satisfactory evidence is defined as:

   a. Performance Bond and Labor and Material Payment Bond.

B. Each form of satisfactory evidence must be in the full amount of the Contract Sum. Satisfactory evidence shall be in force for the duration of the contract, including Contractor warranty periods.

C. Bonding company must be licensed in the State of Minnesota. Bonding company must have a Best rating of A or higher.

5. PROMPT PAYMENT TO SUBCONTRACTORS

Prompt payment shall be made to subcontractors as required by Minnesota Statute 471.425, Subd. 4a: The Contractor shall pay any subcontractor within ten days of the Contractor's receipt of payment from the Owner for undisputed services provided by the subcontractor. The Contractor is required to pay interest of 1-1/2 percent per month or any part of a month to the subcontractor on any undisputed amount not paid on time to the subcontractor. The minimum monthly interest penalty payment for an unpaid balance of $100 or more is $10. For an unpaid balance of less than $100, the Contractor shall pay the actual penalty due to the subcontractor. A subcontractor who prevails in a civil action to collect interest penalties from a Contractor must be awarded its costs and disbursements, including attorney's fees, incurred in bringing the action.

6. ARCHITECT

Where the word “Architect” is referred to throughout the Contract Documents, it shall mean the duly authorized representative of the Owner, which shall be a professional firm commissioned by the Owner directly responsible for a specific project, i.e., Architect, Engineer, or Landscape Architect, acting directly or through its designated representatives who have been delegated the responsibility for preparation of the Contract Documents and administration of the construction, each acting within the scope of the duties and authority delegated to him.

7. FINAL PAYMENT

When the Contract requires the employment of employees for wages by the bidder, final settlement shall not be made until satisfactory showing is made of a Certificate completed by the Commissioner of Taxation (State of Minnesota, Department of Revenue, Form IC-134 (Withholding Affidavit for Contractors)) indicating compliance with the provisions of Minnesota Statutes Section 290.92.

8. COUNTY AND STATE AUDIT

Pursuant to Minn. Stat. Section 16C.05, Sub. 5, the books, records, documents, and accounting procedures and practices of Contractor relative to this agreement shall be subject to examination by the County and the State Auditor. Complete and accurate records of the work performed pursuant to the agreement shall be kept by Contractor for a minimum of six (6) years following termination of this agreement for such auditing purposes. The retention period shall be automatically extended during the course of any administrative or judicial action involving the County regarding matters to which the records are relevant. The retention period shall be automatically extended until the administrative or judicial action is finally completed or until the authorized agent of the County notifies the Contractor in writing that the records need no longer be kept.

9. DATA PRACTICES

The Contractor, its agents, employees and any subcontractors of the Contractor, in providing all services hereunder, agree to abide by the provision of the Minnesota Government Data Practices Act, Minn. Stat. Ch. 13, as amended, and Minn. Rules promulgated pursuant to Ch. 13. The Contractor understands that it must comply with these provisions as if it were a government entity. The Contractor agrees to indemnify and hold the County, its officers, department heads and employees harmless from any claims resulting from the Contractor's unlawful disclosure, failure to disclose or use of data protected under state and federal laws.

10. CONTROLLING LAW

The laws of the State of Minnesota shall govern all questions and interpretations concerning the validity and construction of this agreement, the legal relations between the parties and performance under the agreement. The appropriate venue and jurisdiction for any litigation hereunder will be those courts located within the County of Scott, State of Minnesota. Litigation, however, in the federal courts involving the parties will be in the appropriate federal court within the State of Minnesota.

END OF DOCUMENT 00 73 13

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DOCUMENT 00 73 43 - LABOR AND WAGE RATE REQUIREMENTS

1. OWNER LABOR RATE REQUIREMENTS:

a. Prevailing labor wage rate requirements will be in effect as described herein:

1. Prevailing labor wage rate requirements will be in effect on Work where:

a. The estimated total cost of completing the Work is equal to or greater than $25,000.

Or

b. The estimated total cost of completing the Work is equal to or greater than $2,500 and less than $25,000 and only one trade or occupation is required to complete it.

2. Prevailing labor wage rate requirements will not be in effect on Work where:

a. The estimated total cost of completing the Work is less than $2,500.

Or

b. The estimated total cost of completing the Work is equal to or greater than $2,500 and less than $25,000 and more than one trade or occupation is required to complete it.

b. Where labor wage rate requirements are in effect as described above:

1. Pursuant to Minnesota Statutes 177.41 to 177.44 and corresponding Rules 5200.1000 to 5200.1120 this contract is subject to the prevailing wages as established by the Minnesota Department of Labor and Industry. Specifically, no laborer or mechanic employed directly on the project work site by the contractor, subcontractor, agent, or other person doing or contracting to do all or a part of the work of the project, is permitted to work more hours than the prevailing hours of labor unless paid for all hours in excess of the prevailing hours at a rate of at least 1-1/2 times the hourly basic rate of pay; and a laborer or mechanic may not be paid a lesser rate of wages than the prevailing wage rate in the same or most similar trade or occupation in the area. Failure to comply with the aforementioned may result in civil or criminal penalties.

2. Owner’s general instructions for monitoring prevailing wage standards:

a. All mechanics and laborers, including apprentices and trainees, employed or working directly upon the site of the Work shall be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account, the full amounts due at time of payment computed at wage rates not less than the aggregate of the basic hourly rates and the rates of payments, contributions, or costs for any fringe benefits contained in the wage determination decision of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the Contractor or Subcontractor and such laborers and mechanics. (The Contractor's obligation is to pay the total rate in the far right hand column on these lists regardless of how wages are divided between basic rate and fringe benefit rate.) Each contractor and subcontractor performing work shall post on the project a copy of such wage determination decision at the site of the Work in a conspicuous place(s) for the information of the employees working on the project.

2. PAYROLLS AND BASIC RECORDS:

a. The Contractor shall maintain payrolls and basic records relating thereto during the course of the Work and shall preserve them for a period of three (3) years thereafter for all laborers and mechanics, including apprentices, trainees, watchmen, and guards, working at the site of the Work. Such records shall contain the name and address of each such employee, his correct classification, total rate of pay (including rates of contributions for, or costs assumed to provide, fringe benefits including payment of benefits or contributions to qualified plans), daily and weekly number of hours worked, deductions made and actual wages paid. In addition, the Contractor shall maintain daily time records showing the hours worked by all hourly employees. Such time sheets shall be signed by the employee and the employer and shall be preserved by the employer for a period of one-year following completion of the Work. Such records shall be made available to the Owner upon request.

b. The Contractor shall submit weekly copies of all payrolls to the Owner's project representative with its monthly pay requests. The Contractor shall be responsible for the submission of copies of payrolls of all Subcontractors. The copy shall be accompanied by a statement signed by the Contractor indicating that the payrolls are correct and complete, that the wage rates contained therein are not less than those determined by the Secretary of Labor, and that the classifications set forth for each laborer or mechanic, including apprentices and trainees, conform with the work he performed.

c. The Contractor shall make the records required under this clause available for inspection by the Owner's project representative and shall permit such representatives to interview employees during working hours on the job.

3. WITHHOLDING OF FUNDS:

a. The Owner's project representative may withhold or cause to be withheld from the prime contractor so much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, watchmen, and guards, employed by the Contractor or any Subcontractor on the work the full amount of wages required by the Contract.

b. If any Contractor fails to pay any laborer, mechanic, apprentice, trainees, watchman or guard, employed or working on the site of the Work, all or part of the wages required by the Contract, the Owner's project representative may after written notice to the prime contractor, take such action as may be necessary to cause suspension of any further payments or advances until such violations have ceased.

4. SUBCONTRACTS:

The Contractor agrees to insert the clauses of this section in all subcontracts.

5. CONTRACT TERMINATION – DEBARMENT:

A breach of the paragraphs 1, 2, 3, 4, or 5 of this subsection shall be grounds for termination of the Contract, and/or for debarment.

6. WAGE DETERMINATION SCHEDULE:

Refer to Wage Determination Schedule, which follows this Document.

MINNESOTA DEPARTMENT OF LABOR AND INDUSTRY PREVAILING WAGES FOR STATE FUNDED CONSTRUCTION PROJECTS

⚠ THIS NOTICE MUST BE POSTED ON THE JOBSITE IN A CONSPICUOUS PLACE

Construction Type: Commercial

County Number: 70

County Name: SCOTT

Effective: 2018-12-17 Revised: 2019-01-28

This project is covered by Minnesota prevailing wage statutes. Wage rates listed below are the minimum hourly rates to be paid on this project.

All hours worked in excess of eight (8) hours per day or forty (40) hours per week shall be paid at a rate of one and one half (1 1/2) times the basic hourly rate.

Violations should be reported to:

Department of Labor and Industry
Prevailing Wage Section
443 Lafayette Road N
St Paul, MN 55155
(651) 284-5091
DLI.PrevWage@state.mn.us

* Indicates that adjacent county rates were used for the labor class listed.

County: SCOTT (70)

LABOR CODE AND CLASS		EFFECT DATE	BASIC RATE	FRINGE RATE	TOTAL RATE
LABORERS (101 - 112) (SPECIAL CRAFTS 701 - 730)					
101	LABORER, COMMON (GENERAL LABOR WORK)	2018-12-17	34.11	19.64	53.75
102	LABORER, SKILLED (ASSISTING SKILLED CRAFT JOURNEYMAN)	2018-12-17	34.11	19.64	53.75

103*	LABORER, LANDSCAPING (GARDENER, SOD LAYER AND NURSERY OPERATOR)	2018-12-17	23.02	15.99	39.01
		2019-05-01	24.00	16.96	40.96
104*	FLAG PERSON	2018-12-17	34.11	19.64	53.75
105*	WATCH PERSON	2018-12-17	30.48	19.29	49.77
106*	BLASTER	2018-12-17	34.26	18.54	52.80
107	PIPELAYER (WATER, SEWER AND GAS)	2018-12-17	34.15	19.64	53.79
		2019-05-01	35.30	20.44	55.74
108*	TUNNEL MINER	2018-12-17	32.35	19.64	51.99
		2019-05-01	33.50	20.44	53.94
109	UNDERGROUND AND OPEN DITCH LABORER (EIGHT FEET BELOW STARTING GRADE LEVEL)	2018-12-17	32.35	19.64	51.99
		2019-05-01	33.50	20.44	53.94
110	SURVEY FIELD TECHNICIAN (OPERATE TOTAL STATION, GPS RECEIVER, LEVEL, ROD OR RANGE POLES, STEEL TAPE MEASUREMENT; MARK AND DRIVE STAKES; HAND OR POWER DIGGING FOR AND IDENTIFICATION OF MARKERS OR MONUMENTS; PERFORM AND CHECK CALCULATIONS; REVIEW AND UNDERSTAND CONSTRUCTION PLANS AND LAND SURVEY MATERIALS). THIS CLASSIFICATION DOES NOT APPLY TO THE WORK PERFORMED ON A PREVAILING WAGE PROJECT BY A LAND SURVEYOR WHO IS LICENSED PURSUANT TO MINNESOTA STATUTES, SECTIONS 326.02 TO 326.15.	2018-12-17	34.11	19.64	53.75
111*	TRAFFIC CONTROL PERSON (TEMPORARY SIGNAGE)	2018-12-17	34.11	19.64	53.75
SPECIAL EQUIPMENT (201 - 204)					
201*	ARTICULATED HAULER	2018-12-17	38.13	20.30	58.43
202*	BOOM TRUCK	2018-12-17	38.13	20.30	58.43

203*	LANDSCAPING EQUIPMENT, INCLUDES HYDRO SEEDER OR MULCHER, SOD ROLLER, FARM TRACTOR WITH ATTACHMENT SPECIFICALLY SEEDING, SODDING, OR PLANT, AND TWO-FRAMED FORKLIFT (EXCLUDING FRONT, POSIT-TRACK, AND SKID STEER LOADERS), NO EARTHWORK OR GRADING FOR ELEVATIONS	2018-12-17	23.02	15.99	39.01
		2019-05-01	24.00	16.96	40.96
204*	OFF-ROAD TRUCK	FOR RATE CALL 651-284-5091 OR EMAIL DLI.PREVWAGE@STATE.MN.US			
205	PAVEMENT MARKING OR MARKING REMOVAL EQUIPMENT (ONE OR TWO PERSON OPERATORS); SELF-PROPELLED TRUCK OR TRAILER MOUNTED UNITS.	2018-12-17	30.25	17.65	47.90

HIGHWAY/HEAVY POWER EQUIPMENT OPERATOR

GROUP 2		2018-12-17	34.69	19.76	54.45
306	GRADER OR MOTOR PATROL				
308	TUGBOAT 100 H.P. AND OVER WHEN LICENSE REQUIRED (HIGHWAY AND HEAVY ONLY)				
GROUP 3 *		2018-12-17	36.34	20.30	56.64
		2019-05-01	38.09	20.50	58.59
309	ASPHALT BITUMINOUS STABILIZER PLANT				
310	CABLEWAY				
312	DERRICK (GUY OR STIFFLEG)(POWER)(SKIDS OR STATIONARY) (HIGHWAY AND HEAVY ONLY)				
314	DREDGE OR ENGINEERS, DREDGE (POWER) AND ENGINEER				
316	LOCOMOTIVE CRANE OPERATOR				
320	TANDEM SCRAPER				
322	TUGBOAT 100 H.P AND OVER (HIGHWAY AND HEAVY ONLY)				
GROUP 4 *		2018-12-17	36.04	20.30	56.34
		2019-05-01	37.79	20.50	58.29

323 AIR TRACK ROCK DRILL

324 AUTOMATIC ROAD MACHINE (CMI OR SIMILAR) (HIGHWAY AND HEAVY ONLY)

325 BACKFILLER OPERATOR

327 BITUMINOUS ROLLERS, RUBBER TIRED OR STEEL DRUMMED (EIGHT TONS AND OVER)

328 BITUMINOUS SPREADER AND FINISHING MACHINES (POWER), INCLUDING PAVERS, MACRO SURFACING AND MICRO SURFACING, OR SIMILAR TYPES (OPERATOR AND SCREED PERSON)

329 BROKK OR R.T.C. REMOTE CONTROL OR SIMILAR TYPE WITH ALL ATTACHMENTS

330 CAT CHALLENGER TRACTORS OR SIMILAR TYPES PULLING ROCK WAGONS, BULLDOZERS AND SCRAPERS

331 CHIP HARVESTER AND TREE CUTTER

332 CONCRETE DISTRIBUTOR AND SPREADER FINISHING MACHINE, LONGITUDINAL FLOAT, JOINT MACHINE, AND SPRAY MACHINE

334 CONCRETE MOBIL (HIGHWAY AND HEAVY ONLY)

335 CRUSHING PLANT (GRAVEL AND STONE) OR GRAVEL WASHING, CRUSHING AND SCREENING PLANT

336 CURB MACHINE

337 DIRECTIONAL BORING MACHINE

338 DOPE MACHINE (PIPELINE)

340 DUAL TRACTOR

341 ELEVATING GRADER

345 GPS REMOTE OPERATING OF EQUIPMENT

347 HYDRAULIC TREE PLANTER

348 LAUNCHER PERSON (TANKER PERSON OR PILOT LICENSE)

349 LOCOMOTIVE (HIGHWAY AND HEAVY ONLY)

350 MILLING, GRINDING, PLANNING, FINE GRADE, OR TRIMMER MACHINE

352 PAVEMENT BREAKER OR TAMPING MACHINE (POWER DRIVEN) MIGHTY MITE OR SIMILAR TYPE

354 PIPELINE WRAPPING, CLEANING OR BENDING MACHINE

356 POWER ACTUATED HORIZONTAL BORING MACHINE, OVER SIX INCHES

357 PUGMILL

359 RUBBER-TIRED FARM TRACTOR WITH BACKHOE INCLUDING ATTACHMENTS (HIGHWAY AND HEAVY ONLY)

360 SCRAPER

361 SELF-PROPELLED SOIL STABILIZER

362 SLIP FORM (POWER DRIVEN) (PAVING)

363 TIE TAMPER AND BALLAST MACHINE

365 TRACTOR, WHEEL TYPE, OVER 50 H.P. WITH PTO UNRELATED TO LANDSCAPING (HIGHWAY AND HEAVY ONLY)

367 TUB GRINDER, MORBARK, OR SIMILAR TYPE

GROUP 5 *	2018-12-17	31.65	19.70	51.35

370 BITUMINOUS ROLLER (UNDER EIGHT TONS)

371 CONCRETE SAW (MULTIPLE BLADE) (POWER OPERATED)

372 FORM TRENCH DIGGER (POWER)

375 HYDRAULIC LOG SPLITTER

376 LOADER (BARBER GREENE OR SIMILAR TYPE)

377 POST HOLE DRIVING MACHINE/POST HOLE AUGER

379 POWER ACTUATED JACK

381 SELF-PROPELLED CHIP SPREADER (FLAHERTY OR SIMILAR)

382 SHEEP FOOT COMPACTOR WITH BLADE . 200 H.P. AND OVER

383 SHOULDERING MACHINE (POWER) APSCO OR SIMILAR TYPE INCLUDING SELF-PROPELLED SAND AND CHIP SPREADER

384 STUMP CHIPPER AND TREE CHIPPER

385 TREE FARMER (MACHINE)

GROUP 6 *	2018-12-17	28.00	0.00	28.00

387 CAT, CHALLENGER, OR SIMILAR TYPE OF TRACTORS, WHEN PULLING DISK OR ROLLER

389 DREDGE DECK HAND

391 GRAVEL SCREENING PLANT (PORTABLE NOT CRUSHING OR WASHING)

393 LEVER PERSON

395 POWER SWEEPER

396 SHEEP FOOT ROLLER AND ROLLERS ON GRAVEL COMPACTION, INCLUDING VIBRATING ROLLERS

397 TRACTOR, WHEEL TYPE, OVER 50 H.P., UNRELATED TO LANDSCAPING

COMMERCIAL POWER EQUIPMENT OPERATOR

GROUP 1	2018-12-17	41.14	20.30	61.44

501 HELICOPTER PILOT (COMMERCIAL CONSTRUCTION ONLY)

502 TOWER CRANE 250 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)

503 TRUCK CRAWLER CRANE WITH 200 FEET OF BOOM AND OVER, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 2	2018-12-17	40.80	20.30	61.10

504 CONCRETE PUMP WITH 50 METERS/164 FEET OF BOOM AND OVER (COMMERCIAL CONSTRUCTION ONLY)

505 PILE DRIVING WHEN THREE DRUMS IN USE (COMMERCIAL CONSTRUCTION ONLY)

506 TOWER CRANE 200 FEET AND OVER (COMMERCIAL CONSTRUCTION ONLY)

507 TRUCK OR CRAWLER CRANE WITH 150 FEET OF BOOM UP TO AND NOT INCLUDING 200 FEET, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 3	2018-12-17	39.39	20.30	59.69

508 ALL-TERRAIN VEHICLE CRANES (COMMERCIAL CONSTRUCTION ONLY)

509 CONCRETE PUMP 32-49 METERS/102-164 FEET (COMMERCIAL CONSTRUCTION ONLY)

510 DERRICK (GUY & STIFFLEG) (COMMERCIAL CONSTRUCTION ONLY)

511 STATIONARY TOWER CRANE UP TO 200 FEET

512 SELF-ERECTING TOWER CRANE 100 FEET AND OVER MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)

513 TRAVELING TOWER CRANE (COMMERCIAL CONSTRUCTION ONLY)

514 TRUCK OR CRAWLER CRANE UP TO AND NOT INCLUDING 150 FEET OF BOOM, INCLUDING JIB (COMMERCIAL CONSTRUCTION ONLY)

GROUP 4 *	2018-12-17	39.05	20.30	59.35

515 CRAWLER BACKHOE INCLUDING ATTACHMENTS (COMMERCIAL CONSTRUCTION ONLY)

516 FIREPERSON, CHIEF BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

517 HOIST ENGINEER (THREE DRUMS OR MORE) (COMMERCIAL CONSTRUCTION ONLY)

518 LOCOMOTIVE (COMMERCIAL CONSTRUCTION ONLY)

519 OVERHEAD CRANE (INSIDE BUILDING PERIMETER) (COMMERCIAL CONSTRUCTION ONLY)

520 TRACTOR . BOOM TYPE (COMMERCIAL CONSTRUCTION ONLY)

GROUP 5	2018-12-17	38.13	20.30	58.43

521 AIR COMPRESSOR 450 CFM OR OVER (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)

522 CONCRETE MIXER (COMMERCIAL CONSTRUCTION ONLY)

523 CONCRETE PUMP UP TO 31 METERS/101 FEET OF BOOM

524 DRILL RIGS, HEAVY ROTARY OR CHURN OR CABLE DRILL WHEN USED FOR CAISSON FOR ELEVATOR OR BUILDING CONSTRUCTION (COMMERCIAL CONSTRUCTION ONLY)

525 FORKLIFT (COMMERCIAL CONSTRUCTION ONLY)

526 FRONT END, SKID STEER 1 C YD AND OVER

527 HOIST ENGINEER (ONE OR TWO DRUMS) (COMMERCIAL CONSTRUCTION ONLY)

528 MECHANIC-WELDER (ON POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)

529

POWER PLANT (100 KW AND OVER OR MULTIPLES EQUAL TO 100KW AND OVER) (COMMERCIAL CONSTRUCTION ONLY)

530 PUMP OPERATOR AND/OR CONVEYOR (TWO OR MORE MACHINES) (COMMERCIAL CONSTRUCTION ONLY)

531 SELF-ERECTING TOWER CRANE UNDER 100 FEET MEASURED FROM BOOM FOOT PIN (COMMERCIAL CONSTRUCTION ONLY)

532 STRADDLE CARRIER (COMMERCIAL CONSTRUCTION ONLY)

533 TRACTOR OVER D2 (COMMERCIAL CONSTRUCTION ONLY)

534 WELL POINT PUMP (COMMERCIAL CONSTRUCTION ONLY)

GROUP 6 *	2018-12-17	36.62	20.30	56.92

535 CONCRETE BATCH PLANT (COMMERCIAL CONSTRUCTION ONLY)

536 FIREPERSON, FIRST CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

537 FRONT END, SKID STEER UP TO 1 C YD

538 GUNITE MACHINE (COMMERCIAL CONSTRUCTION ONLY)

539 TRACTOR OPERATOR D2 OR SIMILAR SIZE (COMMERCIAL CONSTRUCTION ONLY)

540 TRENCHING MACHINE (SEWER, WATER, GAS) EXCLUDES WALK BEHIND TRENCHER

GROUP 7	2018-12-17	35.50	20.30	55.80

541 AIR COMPRESSOR 600 CFM OR OVER (COMMERCIAL CONSTRUCTION ONLY)

542 BRAKEPERSON (COMMERCIAL CONSTRUCTION ONLY)

543 CONCRETE PUMP/PUMPCRETE OR COMPLACO TYPE (COMMERCIAL CONSTRUCTION ONLY)

544 FIREPERSON, TEMPORARY HEAT SECOND CLASS BOILER LICENSE (COMMERCIAL CONSTRUCTION ONLY)

545 OILER (POWER SHOVEL, CRANE, TRUCK CRANE, DRAGLINE, CRUSHERS AND MILLING MACHINES, OR OTHER SIMILAR POWER EQUIPMENT) (COMMERCIAL CONSTRUCTION ONLY)

546 PICK UP SWEEPER (ONE CUBIC YARD HOPPER CAPACITY) (COMMERCIAL CONSTRUCTION ONLY)

547 PUMP AND/OR CONVEYOR (COMMERCIAL CONSTRUCTION ONLY)

GROUP 8	2018-12-17	33.49	20.30	53.79

548 ELEVATOR OPERATOR (COMMERCIAL CONSTRUCTION ONLY)

549 GREASER (COMMERCIAL CONSTRUCTION ONLY)

550 MECHANICAL SPACE HEATER (TEMPORARY HEAT NO BOILER LICENSE REQUIRED) (COMMERCIAL CONSTRUCTION ONLY)

TRUCK DRIVERS

GROUP 1		2018-12-17	41.07	9.48	50.55
601	MECHANIC . WELDER				
602	TRACTOR TRAILER DRIVER				
603	TRUCK DRIVER (HAULING MACHINERY INCLUDING OPERATION OF HAND AND POWER OPERATED WINCHES)				
GROUP 2		2018-12-17	23.50	2.79	26.29
604	FOUR OR MORE AXLE UNIT, STRAIGHT BODY TRUCK				
GROUP 3		2018-12-17	16.85	6.49	23.34
605	BITUMINOUS DISTRIBUTOR DRIVER				
606	BITUMINOUS DISTRIBUTOR (ONE PERSON OPERATION)				
607	THREE AXLE UNITS				
GROUP 4 *		2018-12-17	35.82	8.18	44.00
608	BITUMINOUS DISTRIBUTOR SPRAY OPERATOR (REAR AND OILER)				
609	DUMP PERSON				
610	GREASER				
611	PILOT CAR DRIVER				
612	RUBBER-TIRED, SELF-PROPELLED PACKER UNDER 8 TONS				
613	TWO AXLE UNIT				
614	SLURRY OPERATOR				
615	TANK TRUCK HELPER (GAS, OIL, ROAD OIL, AND WATER)				
616	TRACTOR OPERATOR, UNDER 50 H.P.				
SPECIAL CRAFTS					
701	HEATING AND FROST INSULATORS	2018-12-17	44.60	24.40	69.00
		2019-06-01	47.10	24.40	71.50
702*	BOILERMAKERS	2018-12-17	36.50	27.36	63.86
703	BRICKLAYERS	2018-12-17	38.76	20.87	59.63
704	CARPENTERS	2018-12-17	37.18	21.45	58.63
705	CARPET LAYERS (LINOLEUM)	2018-12-17	37.84	19.19	57.03

706	CEMENT MASONS	2018-12-17	38.41	19.67	58.08
707	ELECTRICIANS	2018-12-17	41.56	29.79	71.35
		2019-05-01	44.51	29.79	74.30
708	ELEVATOR CONSTRUCTORS	2018-12-17	48.36	32.65	81.01
		2019-01-01	49.91	39.24	89.15
709	GLAZIERS	2018-12-17	41.19	18.54	59.73
710	LATHERS	2018-12-17	38.47	20.18	58.65
712	IRONWORKERS	2018-12-17	37.10	27.85	64.95
714	MILLWRIGHT	2018-12-17	35.13	24.98	60.11
715	PAINTERS (INCLUDING HAND BRUSHED, HAND SPRAYED, AND THE TAPING OF PAVEMENT MARKINGS)	2018-12-17	36.75	21.24	57.99
716*	PILEDRIVER (INCLUDING VIBRATORY DRIVER OR EXTRACTOR FOR PILING AND SHEETING OPERATIONS)	2018-12-17	38.01	21.08	59.09
		2019-05-01	39.96	21.08	61.04
717	PIPEFITTERS . STEAMFITTERS	2018-12-17	45.82	27.37	73.19
718	PLASTERERS	2018-12-17	38.96	19.45	58.41
719	PLUMBERS	2018-12-17	46.91	23.79	70.70
		2019-05-01	49.66	23.79	73.45
720	ROOFER	2018-12-17	36.26	17.46	53.72
721	SHEET METAL WORKERS	2018-12-17	43.31	27.72	71.03
		2019-05-01	45.91	27.72	73.63

722	SPRINKLER FITTERS	2018-12-17	35.00	4.58	39.58
723*	TERRAZZO WORKERS	2018-12-17	38.91	19.40	58.31
724	TILE SETTERS	2018-12-17	33.55	24.44	57.99
725	TILE FINISHERS	2018-12-17	28.23	19.12	47.35
726	DRYWALL TAPER	2018-12-17	34.51	22.28	56.79
727	WIRING SYSTEM TECHNICIAN	2018-12-17	38.97	17.14	56.11
		2019-07-01	40.17	17.14	57.31
728	WIRING SYSTEMS INSTALLER	2018-12-17	27.30	14.31	41.61
		2019-07-01	28.14	14.31	42.45
729	ASBESTOS ABATEMENT WORKER	2018-12-17	31.68	18.71	50.39
		2019-01-01	32.68	19.66	52.34
730*	SIGN ERECTOR	2018-12-17	28.80	14.92	43.72
		2019-06-01	30.45	14.92	45.37

END OF DOCUMENT 00 73 43

SECTION 01 10 00 – SUMMARY OF WORK

PART 1 - GENERAL

1.1 SUMMARY

A. Three Rivers Park District project involves removing an old house and constructing a new maintenance building at clearly Lake Park, a property which is owned by Scott County. The scope of new construction includes demolition, excavation and associated site work associated with the excavation of and backfilling of those excavations necessary for foundation and building utility placements, concrete and concrete masonry foundation footings and walls, wood framed above grade walls and roof structure, exterior and interior finishes, and all necessary HVAC, plumbing and electrical work necessary for a complete building and as indicated on the drawings and within these specifications.

B. The Owner will be performing work in addition to the general contract, which may take place prior to, during or after the work of this building contract is performed. This includes but is not limited to the follow:

1. Removal of hazardous materials.
2. Installation, upgrades and/or replacement of a well, septic and drain field.
3. Installation of a new fueling island.
4. Purchase and installation of appliances.
5. Installation of various low voltage items.
6. Security system and electric locks.
7. Landscaping.
8. Specialized equipment.
9. Furnishings.

C. The well and septic system work will be taking place the same time as the construction of the building.

D. Prior to start up of the work and building demolition, the Owner will be removing and retaining the following from the existing house (which is to be demolished as a part of this contract):

1. Key boxes.
2. Office furniture.
3. IT equipment.
4. Appliances.
5. Stored equipment, stock and supplies.

E. The work includes all sections that are incorporated herein this specification, specific work sections of division 2 through 48 (except where indicated in the Table of Contents that a specific division is not included) along with divisions 0 and 1, which govern all the specific work involved in the project.

F. Other key items relative to the work and the contract include but are not limited to the following:

1. This **is** a prevailing wage project.
2. All building related permits and reviews shall be paid for, pulled and coordinated by the Contractor.
3. Erosion control, storm water and sediment control shall be placed by the Contractor at the limits of construction activities.

G. This is a single lump sum bid type of project, with the general contractor being responsible for all subcontractors working on the site and providing materials and equipment, as well as any sub-subcontractors and suppliers.

1. There are several Alternates, which are listed on the Bid Form, and are described in the Alternates section.

1.2 SUBMITTALS

A. Permits, Licenses, and Certificates: Submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with applicable building codes, laws, ordinances and environmental regulations bearing on performance of the Work.

1.3 ABESTOS SURVEY OF EXISTING BUILDING

A. An asbestos survey was performed on the existing property and all asbestos materials have been removed. If, however, suspicious materials are encountered during demolition activities, Contractor shall stop work in those areas, contact the Architect and Owner representatives immediately to begin investigations. Costs of investigation and abatement will be covered by the Owner.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. All work included in the entire set of documents (drawings and specifications) is a part of the lump sum bid provided by the contractor, which will be used as the basis of an agreement with Scott County.

B. The contractor shall be responsible for all information and requirements provided within this set of documents and any addenda issued during the bidding process.

1.5 DRAWINGS AND PROJECT MANUAL FOR PROJECT CONSTRUCTION

A. The prime general contractor is responsible to provide subcontractors and suppliers with electronic and/or printed paper copies of the Drawings, Project Manual, and addenda required for the construction of the project. Any and all printing and distribution costs incurred shall borne by the Contractor and not the Owner.

1.6 BUILDING CODES, PLAN REVIEW, AND PERMITS

A. Permit Jurisdiction Agreement
   1. Plan Review will be performed by Scott County.

B. Building Plan Review and Building Permit
   1. Permit fees will be paid by the Contractor.
   2. The Contractor shall secure the Building Permit(s) issued by the County.

C. Documentation

   1. The Contractor shall indicate on the Request for Payment the value of all plan review fees, permits, and inspection fees.

1.7 ACCESS TO SITE AND USE OF THE SITE

A. General: Contractor will have as much use of Project site for construction operations as indicated on the Drawings or as physically possible with the cooperation of the Owner, by the Contract limits and as indicated by requirements of this Section.

   1. Use of Site: Limit use of Project site to work in areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.

      a. Limits: The limits of construction are indicated within the drawing package, on various drawings. All construction activities, including parking, storage, staging, site operations and work areas will be limited to the limits of construction indicated.

      b. An exception to the above will be the entries, exits and drive lanes to the work area or portions of the site perimeter where new utility work is to be performed.

c. Only under special and unusual conditions will the Owner consider temporary use of other portions of the site. The Owner will consider any request on an as-needed basis, with no assurance that use of other portions of the site will be granted.

d. Parking for workers shall be at the project site. Additional parking needs shall be coordinated with the Owner's project representative.

2. **Public Access: Note that the public will continue to access the site via the road directly West of the building site location. Contractor shall take special care to keep the area and the public safe during construction operations. With notice, and when necessary, notify the Owner that the road/path will be blocked off for temporary staging or construction activities.**

1.8 PHASING OF CONSTRUCTION AND KEY DATES

A. General: The project shall be carefully planned and coordinated to limit interference with ongoing city operations and due to the various construction components on this job. The following is a schedule of target dates and completion dates for the project: Schedule can be accelerated at Contractors option, if feasible, and if within the Owner's ability to operate.

Target / contract dates:	
Bid Opening:	August 15, 2019
Tentative contract Award / Notice to Proceed:	August 20, 2019
Execution of Contract / on-site mobilization:	Begin Week of September 2, 2019
Project Punchlist, Substantial Completion:	May 31, 2020
Contractor corrections	directly after issuance of Punch List
Complete Project Closeout	June 15, 2020.

B. Except for rare occasions, and only when a request is made in advance, the Owner will consider making efforts to help with a special shipment or site condition where the limits of use for the contractor are not adequate.

C. The contractor shall plan in advance and work out all site usage, including phasing, location of crane, storage, parking, deliveries and related items. Should the contractor have a better plan, this shall be proposed at the initial pre-construction meeting.

1.9 WORK RESTRICTIONS

A. On-Site Work Hours: Limit work in the existing building to normal business working hours of 7:00 a.m. to 7:00 p.m., Monday through Saturday, unless otherwise indicated.

B. Existing Utility Interruptions: As this facility will not be in use during construction, interruptions will be acceptable within the course of construction. See Section 01 50 00 – Temporary Facilities and Controls for use of utilities during construction.

C. Nonsmoking Building / Property: Smoking is not permitted anywhere on this property.

D. Controlled Substances: Use of controlled substances is not permitted.

1.10 APPROPRIATE WORKPLACE BEHAVIOR

A. It is the Owner's policy to provide a workplace free from violence, threats of violence, harassment, and discrimination. The Owner has established a policy of zero tolerance for violence in the workplace. Contractor who shall enforce this policy on this project and maintain a workplace free from violence, harassment, and discrimination (See definitions, below).

a. This project is an operational park within a residential neighborhood. Foul or Course Language, Violence, Substance Use will not be tolerated in the presence of park patrons.

B. Definitions:

1. Violence is the threatened or actual use of force which results in or has a high likelihood of causing fear, injury, suffering or death. Employees are prohibited from taking reprisal against anyone who reports a violent act or threat.

2. Harassment is the conduct of one employee (toward another employee) which has the purpose or effect of 1) unreasonably interfering with the employee's work performance, and/or 2) creating an intimidating, hostile or offensive work environment. Harassment is not legitimate job-related efforts of supervisor to direct/evaluate an employee or to have an employee improve work performance.

    a. Unlawful discriminatory harassment is harassment which is based on these characteristics: race, color, creed, religion, national origin, sex, disability, age, marital status, status with regard to public assistance or sexual orientation. Managers, supervisors and employees shall not take disciplinary or retaliatory action against employees who make complaints of sexual harassment.

    b. Sexual harassment is unwelcome sexual advances, requests for sexual favors, or sexually motivated physical contact, or other verbal or physical conduct or communication of a sexual nature, when submission to that conduct or communication is 1) made a term or condition, either explicitly or implicitly, of obtaining employment; or 2) is used as a factor in decisions affecting an individual's employment; or 3) when that conduct or communication has the purpose or effect of substantially interfering with an individual's employment or creating an intimidating, hostile or offensive work environment, and the employer knows or should have known of the existence of the harassment and fails to take timely and appropriate action. Examples include but are not limited to insulting or degrading sexual remarks or conduct; threats, demands or suggestions that status is contingent upon toleration or acquiescence to sexual advances; displaying in the workplace sexually suggestive objects, publications or pictures, or retaliation against employees for complaining about the behavior cited above or similar behaviors.

    c. General harassment is harassment which is not based on the above characteristics. Examples may include but are not limited to: physically intimidating behavior and/or threats of violence; use of profanity (swearing), vulgarity; ridiculing, taunting, belittling or humiliating another person; inappropriate assignments of work or benefits; derogatory name calling.

3. Discrimination includes actions which cause a person, solely because of race, color, creed, religion, national origin, sex, disability, age, marital status, status with regard to public assistance or sexual orientation to be subject to unequal treatment.

C. Contractor shall ensure that their managers, supervisors, foremen/women and employees are familiar with policies on appropriate workplace behavior; and shall ensure that their subcontractors are familiarly with this policy. Managers, supervisors and foremen/women will respond to, document, and take appropriate action in response to all reports of violence, threats of violence, harassment or discrimination. Failure to comply with this policy may result in cancellation, termination or suspension of contracts or subcontracts currently held and debarment from further such contracts or subcontracts as provided by statute. If you need additional information or training regarding this policy, please contact the EEO Contract Management Office at 612-297-1376.

1.11 SPECIFICATION AND DRAWING CONVENTIONS

A. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:

1. Imperative mood and streamlined language are generally used in the Specifications. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

2. Specification requirements are required to be performed by Contractor unless specifically stated otherwise.

B. Drawing Coordination: Requirements for materials and products identified on Drawings are described in detail in the Specifications. One or more of the following are used on Drawings to identify materials and products:

1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.

2. Abbreviations: Materials and products are identified by abbreviations published as part of the U.S. National CAD Standard and as scheduled on Drawings.

PART 2- PRODUCTS (Not Used)

PART 3- EXECUTION (Not Used)

END OF SECTION 01 10 00

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SECTION 01 22 00 – ALTERNATES

PART1 - GENERAL

1.1 **SUMMARY**

A. Section includes provisions for possible changes or additions to the work, known as alternates, which will be selected by the Owner, as the Owner so chooses. These may be taken in part, in whole, in any order or not at all.

1.2 **CONDITIONS AND PROCEDURES**

A. Alternates shall include all costs associate with the work as shown and as described in the documents. Costs shall include all materials, labor, shipping, coordination, temporary conditions, overhead and profit.

B. An alternate will be provided only when included within the contract and noted as such.

PART2 -PRODUCTS (Not Used)

PART3 - EXECUTION

3.1 **SCHEDULE OF ALTERNATES**

Alternate #1: Provide complete electrical service to the outbuildings. (Add)

Alternate #2: In lieu of concrete slab and class V aggregate parking area, provide asphalt pavement as shown on the drawings. (Add)

Alternate #3: In lieu of base bid nominal 15” x 8” metal tile wall system, provide horizontal siding as specified. (Add or deduct)

Alternate #4: Provide metal lockers as specified. (Add)

Alternate #5: Provide operable wall panel system at beam line between rooms #112 and #112A. (Deduct)

Alternate #6 Provide fully adhered EPDM roof system in lieu of Structural Standing Seam Metal Roofing / Insulation sections. (Deduct)

END OF SECTION 01 30 05

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SECTION 01 25 00 – SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY:

A. Definitions:

1. Substitutions: Requests for substitutions of products, materials, equipment and methods of construction must be made prior to the time of bid, and are made in accordance with the limits defined in the General Conditions. Once a contract is signed, substitutions shall not be considered except if proposed by the Owner/Architect or under unusual circumstances.

2. All requests for "substitution' or "approved equal" shall be considered by submittal of an industry standard "Substitution Request Form". It shall be the contractor's responsibility to ensure that the substitute product is equal to that specified, or to state any differences on the form.

3. Substitution requests must be made five (5) days prior to the bid due date. Response will be provided via addenda only, within three days of the bid due date.

4. Under special conditions, the architect or owner may choose to review a request for substitution by the contractor but are not obliged to do so.

1.3 QUALITY ASSURANCE

A. Compatibility of Options: Compatibility of products is a basic requirement of product selection. When the Contractor is given the option of selecting between two or more products for use on the project, the product selected must be compatible with other products previously selected, even if the products previously selected were also Contractor options. The complete compatibility between the various choices available to the Contractor is not assured by the various requirements of the Contract documents, but must be provided by the Contractor.

1.4 QUALITY CONTROL:

A. Prior to start-up of demolition work, the general contractor shall schedule a preconstruction meeting between Owner, Architect, demolition contractor, and all sub-contractors that have a related interest including mechanical, electrical, concrete, steel, carpentry and other contractors. Staging, service, Owner's use of site, lead items, shoring, temporary facilities, signage, and all other necessary items shall be addressed. Contractor shall take minutes of the meeting and distribute them to all persons present.

1.5 SUBMITTALS:

A. Substitution Request Submittal:

1. Requests for Substitutions: During the bidding phase, submit each request for substitution, using a "Substitution Request Form" provided by the product provider requesting substitution. Contractor shall fill out form completely: in each request identify the product or fabrication or installation method to be replaced by the substitution; include related specification section and drawing numbers, and complete documentation showing compliance with the requirements for substitutions.

2. It is in the best interest of the submitting contractor to attach a list of projects built in the State of Minnesota where the proposed product has been previously installed. Include a contact name and date of construction whenever possible.

3. A submittal is submitted via a fax is by nature illegible or incomplete, the submitter should be prepared for rejection. A fax submittal does not properly convey the information required by the Architect to properly review the system. Only mailed or delivered submittals shall be considered and are required for processing and review by the Architect. Emailed material will also be considered.

B. Substitution requests shall be received by the Architect no later **than five (5) days prior to bid due date.**

Approvals will be indicated in addenda. Only approvals will be indicated in addendum. There is no obligation by the Architect to review submittals, return mail or consider a substitute product, if not submitted as noted within this section. A standard submittal form commonly used in the industry is acceptable provided it outlines all required information included any variation with the base spec, color limitations, delivery issues, and other deviations from the base spec.

C. Approvals shall be acknowledged by addendum only. There are no verbal approvals. Approval will not be provided over the telephone, the fax machine or by mail. Preliminary or "tentative" decisions are not provided. A separate category for "Approved Equals" is included in each addendum: refer to this when bidding.

1. The decision by the Architect, on whether a product is acceptable or not for the project, is final. In no cases shall the submitting party determine if their project is “equal” or not, and the rejected product supplier shall not provide a bid to the general contractor unless they are prepared to purchase the product(s) specified and approved by other suppliers.

PART 2 - PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION 01 25 00

SECTION 01 40 00 - QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for quality assurance and quality control where indicated in Specification Sections.

B. Testing and inspecting services, where indicated, are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
3. Specific test and inspection requirements are not specified in this Section.
4. Testing and inspections are to be paid by the Owner, except as otherwise indicated.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Preconstruction Testing: Tests and inspections performed specifically for the Project before products and materials are incorporated into the Work, to verify performance or compliance with specified criteria.

D. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.

E. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.

F. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

G. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.

H. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

I. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.3 CONFLICTING REQUIREMENTS

A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

1.4 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

1.5 REPORTS AND DOCUMENTS

A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and re-inspection.

B. Manufacturer’s Field Reports: Prepare written information documenting tests and inspections specified in other Sections. Include the following:

1. Name, address, and telephone number of representative making report.
2. Statement on condition of substrates and their acceptability for installation of product.
3. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.

4. Results of operational and other tests and a statement of whether observed performance complies with requirements.
5. Other required items indicated in individual Specification Sections.

C. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.6 QUALITY ASSURANCE

A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

E. Professional Engineer Qualifications: A Professional Engineer licensed by the State of Minnesota and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for design and installations of the system, assembly, or products which are similar in material, design, and extent to those indicated for this Project.

F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.

G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329 and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.

H. Manufacturer’s Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

I. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance test methods, comply with the following:

1. Contractor responsibilities include the following:
   a. Provide test specimens representative of proposed products and construction.
   b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
   c. When testing is complete, remove test specimens, assemblies, and mockups**,** unless indicated as acceptable to remains part of the work.

2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

1.7 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor and the Contract Sum will be adjusted by Supplemental Agreement.

B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.

2. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.

3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.

4. Where quality-control services are indicated as Contractor’s responsibility, submit a certified written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer’s Field Services: Where indicated, engage a manufacturer's representative to observe and inspect the Work. Manufacturer's representative's services include examination of substrates and conditions, verification of materials, inspection of completed portions of the Work, and submittal of written reports.

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.

E. Contractor’s Testing Agency Responsibilities: Cooperate with Architect and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.

3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.8 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage qualified testing agencies and special inspectors to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, as indicated in Statement of Special Inspections, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect, with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.

B. Special Structural Inspection Form:
1. The Special Structural Testing and Inspection Program Summary Schedule included at the end of this section shall be submitted with the Building Permit Application.
2. A signed form will be furnished by the Architect prior to construction.

PART 2- PRODUCTS (Not Used)

PART 3- EXECUTION

3.1 TEST AND INSPECTION LOG

A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:

1. Date test or inspection was conducted.
2. Description of the Work tested or inspected.
3. Date test or inspection results were transmitted to Architect.
4. Identification of testing agency or special inspector conducting test or inspection.

B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's reference during normal working hours.

3.2 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Section 01 70 00.

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 40 00

SECTION 01 45 00 - SUBSURFACE UTILITY LOCATE REQUIREMENTS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. The 2017 Edition of the Gopher State One Call Handbook, incorporated by reference and available online at www.gopherstateonecall.org.

C. Minnesota Statute Chapter 216D, incorporated by reference and available online at http://www.leg.state.mn.us/leg/statutes.asp.

D. Minnesota Rules Chapter 7560, incorporated by reference and available online at http://www.leg.state.mn.us/leg/statutes.asp.

E. Document CI/ASCE 38-02, entitled “Standard Guidelines for the Collection and Depiction of Existing Subsurface Utility Data,” is incorporated by reference.

1.2 SUMMARY

A. This Section includes requirements for underground utility location by the Contractor, including but not limited to public and private underground facilities.

B. The conditions of this Section apply if and only if Work includes excavation, as defined by Minnesota Statute Chapter 216D.

1.3 MEASUREMENT AND PAYMENT

A. Cost for acceptable private and Park District owned utility locates and associated Work shall be incidental to the Contract with no direct payment being made to the Contractor.

B. All costs associated with Gopher State One Call notification and administration, coordination with facility operators, and other conditions of this Section shall be considered incidental.

1.4 DEFINITIONS

A. The following defined terms are abbreviated, descriptive definitions intended for the purpose of general understanding of the Contract. The Contractor shall read and understand the full meanings of all terms defined in the Gopher State One Call Handbook, Minnesota Statute Chapter 216D, and Minnesota Rules Chapter 7560 prior to commencing Work.

1. Excavation: an activity that move, removes, or otherwise disturbs the soil by use of a motor, engine, hydraulic or pneumatically powered tool, or machine-powered equipment of any kind, or by explosives.

2. Excavator: a person who conducts excavation.

3. Notification center: a center that receives notice from excavators or planned excavation or other requests for location and transmits this notice to participating operators.

4. Operator: a person who owns or operates an underground facility.

5. Person: the state, a public agency, a local governmental unit, an individual, corporation, partnership, association, or other business or public entity or a trustee, receiver, assignee, or personal representative of any of them.

6. Private and Park District owned underground facility: also called customer-owned facility, an underground facility installed beyond the termination point of the operator and the responsibility of the Owner. An example of this is a buried electric line installed after the meter which serves site lighting adjacent to a building.

7. Private utility locator: a person who provides locating services for private and Park District owned underground facilities.

8. Underground facility: an underground line, facility, system, and its appurtenances used to produce, store, convey, transmit, or distribute communications, data, electricity, power, heat, gas, oil, petroleum products, water including storm water, steam, sewage, and other similar substances.

9. Utility quality level: a professional opinion about the quality and reliability of utility information, ranging from the most precise and reliable, level A, to the least precise and reliable, level D. The utility quality level must be determined in accordance with guidelines established by document CI/ASCE 38-02, which is a referenced document of this Section.

1.5 SUBMITTALS

A. Pre-excavation Notification: From the Contractor to the Architect, prior to commencing excavation, stating that all underground utility locates have been performed, reviewed, and recorded in compliance with state law and the Contract. This notification is considered incidental.

B. Post-excavation Records: From the Contractor to the Architect, handwritten field notes on project Drawings that depict all discrepancies between Drawings and actual conditions. This includes, but is not limited to, all utilities discovered, disturbed, or relocated by the Contractor with alignment, buried depth, size, or type not matching those shown on Drawings, regardless of abandoned, active, or out-of-service status. These records are considered incidental.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.1 PREPARATION

A. Contact Gopher State One Call at (651) 454-0002 not less than 48 hours prior to excavation.

1. Gopher State One Call is the one-call notification center for the state of Minnesota. Gopher State One Call does not physically locate, or maintain records, of underground facilities. Gopher State One Call only facilitates communication between facility operators and excavators.

2. The facility operator(s) are required by state laws to locate and mark or otherwise provide the approximate horizontal location of the underground facilities of the operator(s).

3. The notice is valid for 14 days from the start time stated on the notice, unless arrangements are made with the operators affected to periodically verify or refresh the marks, in which case the notice may be valid for up to six months from the start time stated on the notice. If excavation activities will continue

after the expiration time, the Contractor is responsible to serve an additional notice before the expiration time of the original notice.

4. The Architect has depicted all known underground utility information on the Drawings to utility quality level D.

    a. The utilities shown on the drawings are shown based on information provided to the Architect and are not guaranteed.

    b. The Contractor is solely responsible for determining the horizontal and vertical location of all utilities prior to commencing any excavation Work.

    c. Should unmapped or incorrectly mapped subsurface utilities be encountered during field locates, include this information in the Pre-excavation Notification to the Architect.

    d. The Owner has good cause to believe that the underground facilities shown are inclusive of all underground facilities within the Work limits. However, the Owner makes no guarantee that the utility information shown in the Contract is complete or accurate. Additionally, private underground facilities may be present and not depicted.

B. Locate all private and Park District owned utilities within the actual limits of Work. Utilities must be marked with paint or flags or a combination thereof. The Contractor shall furnish all Drawings to the private utility locator for use and reference. The private utility locator shall schedule its work such that it immediately follows the Gopher State One Call locates, whenever practical.

C. Notify the Owner when underground facilities are marked in the field by operators and private utility locator, so that the Owner can document marked locations with GPS or digital photos.

D. Contractor shall maintain all field locates for the duration of the project.

E. Should unmapped or incorrectly mapped subsurface utilities be encountered during excavation work, notify the Architect immediately and provide written documentation indicating the horizontal location and approximate depth in the Post-excavation Records to the Architect.

F. Preserve existing utilities to remain as shown by Contract documents and/or field locates. Unless otherwise specified by the Contract, existing utilities are to remain in-place and provide continual service throughout construction. The following conditions are considered incidental.

1. Provide adequate means of support and protection of subsurface utilities and associated utility appurtenances during construction to avoid damage.
2. Coordinate with the Owner and affected facility operators if subsurface utilities or associated utility appurtenances are affected by construction or accidentally encountered and require temporary or permanent adjustment or relocation.
3. Repair damaged utilities to the satisfaction of the Owner and affected facility operator.

END OF SECTION 01 45 00

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SECTION 01 45 33 - STRUCTURAL TESTS AND SPECIAL INSPECTIONS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 INTENT AND CONDITIONS

A. Intent:
1. For compliance with the Minnesota State Building Code, the Owner shall employ and pay for a special inspector (or inspectors) as required by Chapter 17 of the International Building Code.
2. Duties and responsibilities of the special inspector(s) shall be as outlined in Chapter 17 of the International Building Code and as herein specified.
3. Define and coordinate structural tests and special inspection services.
4. Define and coordinate conventional testing and inspection services.
5. Testing and Inspection services are intended to assist in determining probable compliance of the work with requirements specified. These services do not relieve the Contractor of responsibility for compliance with the requirements of the Contract Documents.

B. Conditions:
1. If inspection of fabricator's work is required, the Owner may require testing and inspection of the work at the plant, before shipment. Owner, Architect and Structural Engineer of Record (SER) reserve the right to reject material not complying with Contract Documents.
2. Perform testing and inspection in accordance with industry standard used as reference for specific material or procedure unless other criteria are specified. In the absence of a referenced standard, accomplish tests in accordance with generally accepted industry standards.
3. Failure to detect defective work or materials shall in no way prevent later rejection if defective work or materials are discovered.

1.3 RELATED REQUIREMENTS

A. Refer to individual technical specification sections for additional qualifications, inspections, tests, frequency and standards required.

1.4 DEFINITIONS

A. Testing: Evaluation of systems, primarily requiring physical manipulation and analysis of materials, in accordance with approved standards.

B. Inspection: Evaluation of systems, primarily requiring observation and judgment.

C. Structural Tests and Special Inspections: Structural Tests and Special Inspection Services herein include items required by Chapter 17 of the International Building Code as adopted by the Minnesota State Building Code, and other items which in the professional judgement of the Structural Engineer of Record, are critical to the integrity of the building structure.

D. Conventional Testing and Inspections: Conventional Testing and Inspection Services herein describe those items not specially required by Code but may be considered essential to the proper performance of the building systems.

E. Architect of Record: The prime consultant in charge of overall design and coordination of the Project.

F. Structural Engineer of Record (SER): The Licensed Engineer in responsible charge of the structural design for the Project.

G. Licensed Structural Engineer: A professional engineer with education and experience in the design of structures similar to this Project and licensed in State in which Project is located.

H. Testing Agency (TA):
   a. Testing Agency: Approved independent testing agency acceptable to the Owner, Architect, SER and as noted below:
   b. Authorized to operate in the State in which the project is located and experienced with the requirements and testing methods specified in the Contract Documents.
   c. Meeting applicable requirements of references stated in paragraph 1.4.
   d. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards, or to accepted values of natural physical constants.

I. Special Inspector (SI): A properly qualified individual or firm performing special inspections.

J. The categories of special inspector are:
   1. Special Inspector - Technical I, II and III: Usually an employee of a testing agency:
      a. Technical I (Sections 31 20 00) - Technician shall be under the direct supervision of a licensed civil/geotechnical engineer regularly engaged in this type of work. Work shall be performed in a qualified geotechnical/testing laboratory.
      b. Technical I (Sections 03 30 00)
         1) ACI Certified Concrete Field Testing Technician – Grade I.
         2) ACI Certified Concrete Strength Testing Technician.
         3) ACI Certified Concrete Laboratory Testing Technician – Grade 1.
         4) ACI Certified Concrete Construction Inspector-In-Training.
         5) Inspector shall be employed by a testing laboratory, experienced in the type of work being performed, and under the direct supervision of a licensed civil/structural engineer.
      c. Technical I (Section 04 20 00) - Technician shall be under the direct supervision of a licensed civil/structural engineer regularly engaged in testing and inspection of this type of work. The licensed engineer shall review and approve all inspection reports.
      d. Technical I (Section 05 12 00) - Non-destructive Testing Technician SNT-TC-1A Level I, and/or AWS Certified Associate Weld Inspector (CAWI).
      e. Technical II (Sections 31 20 00) - Technician with a minimum of 2 years' experience, or a graduate engineer, and is an employee of a qualified and approved geotechnical/technical laboratory, under the direct supervision of a licensed civil/geotechnical engineer regularly engaged in this type of work.
      f. Technical II (Sections 03 30 00)
         1) ACI Certified Concrete Laboratory Testing Technician - Grade II.
         2) ACI Certified Laboratory Aggregate Testing Technician.
         3) ACI Certified Concrete Construction Inspector.
         4) Inspector shall be employed by a testing laboratory, experienced in the type of work being performed, and under the direct supervision of a licensed civil/structural engineer.
      g. Technical II (Section 04 20 00) - Graduate civil/structural engineer, with experience in this type of work. Supervised by a licensed civil/structural engineer. The licensed engineer shall review and approve all inspection reports.
      h. Technical II (Section 05 12 00) - Non-destructive Testing Technician ASNT TC-1A Level II, (NDE Technician II), AWS/CAWI, with minimum 3 years' experience, or an AWS/CWI.
   2. Special Inspector - Structural I
      a. Structural I (Sections 04 20 00, 05 12 00) - Graduate civil/structural engineer, or other personnel acceptable to the SER, with experience in the design of structural systems of this

type. Inspections shall be performed under the direct supervision of a licensed civil/structural engineer.

K. Building Official: The Officer or duly authorized representative charged with the administration and enforcement of the State Building Code.

1.5 REFERENCES

A. See technical specification sections for specific references.
1. ANSI/ASTM E329 – Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
2. ASTM E543 – Standard Practice for Agencies Performing Non-destructive Testing.
3. ASTM E548 – Standard Guide for General Criteria Used for Evaluating Laboratory Competence.
4. ASTM C1077 – Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation.
5. ASTM C1093 – Standard Practice for the Accreditation of Testing Agencies for Unit Masonry.
6. ANSI/ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in the Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction.

B. Minnesota State Building Code.

C. International Building Code.

1.6 RESPONSIBILITIES/AUTHORITY

A. Structural Tests and Special Inspections:
1. Special Inspector:
   a. Attend all pre-installation meetings to review scope of structural tests and special inspections.
   b. Test and/or inspect the work assigned for conformance with the building department approved plans, specifications, and applicable material and workmanship provisions of the code. Perform testing and inspection in a timely manner to avoid delay of work.
   c. Bring nonconforming items to the immediate attention of the Contractor for correction, then, if uncorrected after a reasonable period of time, to the attention of the Structural Engineer of Record, the Building Official, and to the Architect.
   d. Submit test and/or inspection reports to the Building Official, Contractor, the Structural Engineer of Record, and other designated persons in accordance with the Structural Testing and Special Inspection Schedule.
   e. Submit a final signed report stating whether the work requiring special inspection was, to the best of the inspector’s knowledge, in conformance with the approved plans, specifications and the applicable workmanship provisions of the code.
   f. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
2. Architect:
   a. Coordinate the flow of reports and related information to expedite resolution of construction issues.
   b. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.
   c. Complete and sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction. Provide a completed copy of the schedule to all signed parties including Building Official.
3. Structural Engineer of Record:
   a. Identify items requiring structural testing and special inspection including special cases.
   b. Define "type" of special inspector required for "description" of work indicated on the Structural Testing and Special Inspection Schedule.

c. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.
d. Complete and sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
e. Review reports issued by all special inspectors.
f. If engaged as a special inspector, provide structural testing and special inspection services as noted in Article 1.6.A.1.

4. Testing Agency:
   a. When engaged as a special inspector, provide structural testing and special inspection services as noted in Item 1.6.A.1.
   b. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
   c. Attend pertinent pre-installation meetings to review scope of structural testing and special inspection.
5. Contractor:
   a. Arrange and attend all pre-installation meetings to review scope of structural testing and special inspection. Include the Building Official, Owner, Architect, SER, Testing Agency and other parties concerned.
   b. Post or make available the Structural Testing and Special Inspection Schedule within project site office. Provide timely notification to those parties designated on the schedule so they may properly prepare for and schedule their work.
   c. Provide special inspector access to the approved plans and specifications at the project site.
   d. Review all reports issued by special inspectors.
   e. Retain at the project site all reports submitted by the special inspectors for review by the building official upon request.
   f. Correct in a timely manner, deficiencies identified in inspection and/or testing reports.
   g. Provide safe access to the work requiring inspection and/or testing.
   h. Provide labor and facilities to provide access to the work and to obtain, handle and deliver samples, to facilitate testing and inspection and for storage and curing of test samples.
   i. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
   j. Verification of conformance of work within specified tolerances is solely the responsibility of the Contractor.
6. Fabricator:
   a. Submit a Certificate of Compliance to the Building Official, Special Inspector, and Structural Engineer of Record stating the work was performed in accordance with the Contract Documents.
   b. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.
7. Building Official:
   a. Review all special inspector qualifications.
   b. Review all fabricators who perform work in their shop, which requires special inspection.
   c. Accept and sign completed Structural Testing and Special Inspection Schedule.
   d. Review reports and recommendations submitted by special inspector.
   e. Review the "final signed reports" submitted by special inspector. These documents must be accepted and approved by the building department prior to issuance of a Certificate of Occupancy.
   f. Determine work, which, in the Building Officials opinion, involves unusual hazards or conditions.
8. Owner:
   a. Provide and pay cost of structural testing and special inspection services.
   b. Provide special inspector with Contract Documents and accepted shop drawings.
   c. Provide special inspectors and testing agencies with full access to the site at all times.
   d. Sign the Structural Testing and Special Inspection Schedule in conjunction with other responsible parties prior to commencing construction.

B. Inspections by Building Official: provide timely notice for inspections performed by the building official, as required by IBC Chapter 17, the State Building Code, and local ordinance.

1.7 INSPECTION NOTICES

A. Contractor: Provide minimum of 24 hours notice for all items requiring testing or inspection. Do not place items requiring testing and inspection services prior to or during placement until testing and inspection services are available. Do not enclose or obscure items requiring testing and inspection services after placement until testing and inspection services are performed.

1.8 REPORTS

A. Testing agency and/or special inspectors shall submit a report in accordance with the Structural Testing and Special Inspection Schedule and shall conduct and interpret tests and inspections and state in each report whether; (1) test specimens and observations comply with Contract Documents, and specifically state any deviations, (2) record types and locations of defects found in work, (3) record work required and performed, to correct deficiencies.

B. Submit reports for structural testing and special inspection, in timely manner to the Contractor, Building Official, SER, and Architect.
   1. Submit reports for ongoing work, to provide the information noted below:
      a. Date issued.
      b. Project title and number.
      c. Firm name and address.
      d. Name and signature of tester or inspector.
      e. Date and time of sampling.
      f. Date of test or inspection.
      g. Identification of product and specification section.
      h. Location in project, including elevations, grid location and detail.
      i. Type of test or inspections.
      j. Results of tests or inspections and interpretation of same.
      k. Observations regarding compliance with Contract Documents or deviations there from.
   2. Submit final signed report stating that, to the best of the special inspector’s knowledge, the work requiring testing and/or inspection conformed to the Contract Documents.

1.9 FREQUENCY OF TESTING AND INSPECTION

A. For detailed requirements see individual technical specification sections, and Part 3 of this section.

1.10 PROTECTION AND REPAIR

A. Upon completion of testing, sample-taking, or inspection, repair damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed surfaces, as judged solely by the Architect/Engineer of Record. Protect work exposed by or for testing and/or inspection and protect repaired work. Repair and protection is the Contractor's responsibility, regardless of the assignment of responsibility for testing and/or inspection.

1.11 TESTS TO DEMONSTRATE QUALIFICATION

A. If the Contractor proposes a product material, method, or other system that has not been pre-qualified, the Architect or SER may require applicable tests, to establish a basis for acceptance or rejection. These tests will be paid for by the Contractor.

B. The Architect or SER reserves the right to require certification or other proof that the system proposed, is in compliance with any tests, criteria or standards called for. The certificate shall be signed by a representative of an independent testing agency.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCOPE OF STRUCTURAL TESTS AND SPECIAL INSPECTIONS

A. Refer to individual specification section articles for Quality Control testing and inspection items.

3.2 STRUCTURAL TESTS AND SPECIAL INSPECTIONS PROGRAM SUMMARY

A. The parties involved shall complete and sign the Structural Testing and Special Inspection Schedule. The completed schedule is an element of the Contract Documents and after permit issuance, becomes part of the building department approved plans and specifications. The completed schedule shall include the following:
   1. Specific listing of items requiring inspection and testing.
   2. Associated specification section which defines applicable standards by which to judge conformance with approved plans and specifications in accordance with IBC Chapter 17 as adopted by the State Building Code. The specification section should also include the degree or basis of inspection and testing; i.e., intermittent/will-call or full-time/continuous.
   3. Frequency of reporting, i.e., intermittent, weekly, monthly, per floor, etc.
   4. Parties responsible for performing inspection and testing work.
   5. Required acknowledgments by each designated party.

B. See attached "Structural Testing and Special Inspection Schedule".

END OF SECTION 01 45 33

STRUCTURAL TESTS AND SPECIAL INSPECTIONS SCHEDULE
Project Name:
Location:
Permit No.:_____(1)

STRUCTURAL TESTS AND SPECIAL INSPECTIONS				
Specification Reference (2)	**Description (3)**	**Type of Inspector (4)**	**Report Frequency (5)**	**Assigned Firm (6)**
03 10 00	Concrete Formwork	Tech II	Periodic	
03 20 00	Concrete Reinforcement Footings, Foundation Walls, and Columns	Tech II	Periodic	
03 30 00	Cast-In-Place Concrete Material Sampling & Testing	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Concrete Mix Verification	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Concrete Placement	Tech I	Daily	
03 30 00	Cast-In-Place Concrete Protection & Curing	Tech II	Daily	
03 30 00	Cast-In-Place Concrete Embedded Items	Tech II	Periodic	
04 20 00	Unit Masonry Material Testing	Tech II	Periodic	
04 20 00	Unit Masonry Preparation & Placement	Tech II	Periodic	
04 20 00	Unit Masonry Reinforcement	Struc I	Periodic	
04 20 00	Unit Masonry Grouting	Tech II	Daily	
05 12 00	Structural Steel High Strength Bolting	Tech II	Periodic	
05 12 00	Structural Steel Welding	Tech I / Tech II	Periodic	
05 12 00	Structural Steel Mechanical Fasteners	Tech I	Periodic	
05 12 00	Structural Steel General Configuration	Struc I	Periodic	
05 31 23	Steel Roof Deck Welding	Tech II	Periodic	
31 20 00	Earthwork	Tech II	Daily	

Notes: This schedule to be filled out and included in the project specification. Information unavailable at that time shall be filled out when applying for a building permit.
(1) Permit No. to be provided by the Building Official.
(2) Reference to specific technical scope section in program.
(3) Use descriptions per IBC Chapter 17, as adopted by State Building Code.
(4) Special Inspector – Technical, Special Inspector – Structural.
(5) Weekly, monthly, per test/inspection, per floor, etc.
(6) Firm contracted to perform services.

ACKNOWLEDGEMENTS
Each appropriate representative shall sign below:

Owner:	Firm:	Date:
Contractor:	Firm:	Date:
Architect:	Firm:	Date:
SER:	Firm: Meyer, Borgman, Johnson	Date:
SI-S:	Firm:	Date:
TA:	Firm:	Date:
SI-T:	Firm:	Date:
TA:	Firm:	Date:
SI-T:	Firm:	Date:
F:	Firm:	Date:
F:	Firm:	Date:

* The individual names of all prospective special inspectors and the work they intend to observe shall be identified. (Use reverse side of form, if more room is needed.).

LEGEND:
SER = Structural Engineer of Record
SI-S = Special Inspector – Structural
TA = Testing Agency
SI-T = Special Inspector – Technical
F = Fabricator.
Accepted for the Building Department By_____ Date._____

SECTION 01 50 00 – TEMPORARY FACILITIES AND CONTROLS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for temporary utilities, support facilities, and security and protection facilities and procedures for Discovery of Contaminated Materials and Regulated Wastes.

B. Related Requirements:

1. Section 01 10 00 "Summary"
2. Division 22 “Plumbing”
3. Division 26 “Electrical”
4. Division 33 “Utilities”

1.2 USE CHARGES

A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner’s construction forces, Architect, occupants of project, testing agencies, and authorities having jurisdiction.

B. Water and Sewer Service from Existing System: Water from Owner’s existing water system is available for use without payment of use charges. Provide connections and extensions of services as required for construction operations.

C. Electric Power Service from Existing System: Electric power from Owner’s existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

1.3 INFORMATIONAL SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

B. Stormwater Pollution Prevention: Show compliance with requirements of SWPP General Permit or authorities having jurisdiction, whichever is more significant.

C. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire prevention program.

1.4 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.

C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

1.5 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Engage Installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance of such permanent service regardless of previously assigned responsibilities.

PART 2- PRODUCTS

2.1 MATERIALS

A. As determined necessary by the contractor but not required by the owner- Chain-Link Fencing.

B. Wood: As required for temporary enclosures
   1. Plywood: Minimum ½" thick
   2. Misc. Wood Framing: 2x wood framing as needed

C. Plastic wrapping: As required by conditions for temporary enclosures, drop cloths or other conditions needing protection for various circumstances required during the course of construction or specifically listed in this specification.

D. Recycling / Repurposing: In accordance with Construction Waste Management, all materials used for temporary facilities shall be recycled, or available for repurposing.

2.2 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. Keep office clean and orderly.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated, ABC; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return-air grille in system and remove at end of construction and clean HVAC system as required in Section 01 70 00.
   4. Ventilation: Provide portable fans for use in ventilating spaces were required for construction activities.

PART 3- EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 AIR, LAND, AND WATER POLLUTION

A. General
   1. The Contractor shall schedule and conduct construction operation in a manner that will prevent, control, minimize, or abate pollution of air, land, and water. Contractor shall obtain all necessary permits and permits for temporary work not shown in the Contract.
   2. The Contractor shall be responsible for regular cleaning, on a daily basis, from all construction activities.

B. Discovery of Contaminated Materials and Regulated Wastes
   1. If during the course of the Project, the Contractor unexpectedly encounters any of the following conditions indicating the possible presence of previously unforeseen contaminated soil, contaminated water, or regulated waste, the Contractor shall immediately stop work in the vicinity, notify the Architect, and request suspension of work in the vicinity of the discovery area.

   2. A documented inspection and evaluation will be conducted prior to the resumption of work. The Contractor shall not resume work in the suspected area without authorization by the Owner.

   3. Indicators of contaminated soil, ground water or surface water include, but are not limited to the following:
      a. Odor including gasoline, diesel, creosote (odor of railroad ties), mothballs, or other chemical odor.
      b. Soil stained green or black (but not because of organic content), or with a dark oily appearance, or any unusual soil color or texture.
      c. A rainbow color (sheen) on surface water or soil.

   4. Indicators of regulated wastes include, but are not limited to the following:
      a. Cans, bottles, glass, scrap metal, wood (indicators of solid waste and possible dump)
      b. Concrete and asphalt rubble (indicators of demolition waste).
      c. Roofing materials, shingles, siding, vermiculite, floor tiles, transite or any fibrous material (indicators of demolition waste that could contain asbestos, lead or other chemicals).
      d. Culverts or other pipes with tar-like coating, insulation or transite (indicators of asbestos).
      e. Ash (ash from burning of regulated materials may contain lead, asbestos or other chemicals).
      f. Sandblast residue (could contain lead).
      g. Treated wood including, but not limited to products referred to as green treat, brown treat and creosote (treated wood disposal is regulated).
      h. Chemical containers such as storage tanks, drums, filters and other containers (possible sources of chemical contaminants).
      i. Old basements with intact floor tiles or insulation (could contain asbestos), sumps (could contain chemical waste), waste traps (could contain oily wastes) and cesspools (could contain chemical or oily wastes).

C. Water Protection
   1. The Contractor shall take all necessary precautions and actions to prevent pollution of ground, flowing, and impounded waters of the State with any particulate or liquid matter that may be harmful to fish and wild life or detrimental to public use of the water.

   2. The Contractor shall prevent siltation and the resulting turbidity of public waters.
      a. Water containing sediment shall not be allowed to enter public waters until its sediment content has been reduced by filtration, settlement, or other means to the appropriate standard.
      b. When turbidity standards have not been established for a public water, the turbidity of the effluent shall be not more than that of the water into which it is discharged or will eventually enter.

3. Wash water or waste from concrete mixing operations shall not be allowed to enter streams and public waters.
4. The Contractor shall minimize the crossing of streams and rivers with hauling equipment.
    a. Temporary bridging shall be used where an appreciable number of crossings are necessary.
    b. The Contractor shall clear the crossings of temporary construction as soon as practical after the purpose has been fulfilled.
5. The Contractor shall prevent water pollution from haul roads, work platforms, temporary earth fills, and other temporary construction used to facilitate bridge or culvert construction.

D. Erosion Control
1. The Contractor shall comply with all applicable laws, ordinances, regulations, orders, and decrees pertaining to erosion control, sediment control, and storm water management affecting the conduct of the work.

2. When required, the Contractor shall obtain the National Pollution Discharge Elimination System (NPDES) permit prior to starting work.

    a. No work shall be initiated until the Minnesota Pollution Control Agency's (MPCA) letter of coverage has been posted on site by the Contractor, or the Contractor verifies to the Architect that the permit has been applied for by registered mail to the MPCA a minimum of seven days before starting soil disturbing activities.

3. General Requirements
    a. The Contractor shall schedule and conduct construction activities in a manner that will minimize soil erosion and the resulting siltation and turbidity of surface waters.

    b. Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties and walkways, according to the SWPPP Plan.

    c. Comply with requirements of authorities having jurisdiction.

    d. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.

    e. The Contractor shall comply by the requirements herein regardless whether or not an NPDES permit for the work is required.

4. Before Construction
    a. The Contractor shall install temporary sediment control measures in areas tributary to public waters before construction begins in a drainage area.

E. Quality Control
1. The Contractor shall be responsible for maintaining a quality control program to ensure that erosion is controlled, that is sedimentation is prevented and that provisions of permits are adhered to. The quality control program shall consist of:
    a. Ensuring that permit requirements related to the contractors construction activities are adhered to.
    b. Conducting the inspections required as a part of the permits.
    c. Maintaining the SWPPP Plan inspection log
    d. Ensuring that erosion control is incorporated into the work in a timely manner and that disturbed areas are stabilized with mulch/seed or vegetative cover on a section by section basis.
    e. Ensuring that temporary erosion control devices are maintained.
    f. Ensuring that temporary erosion control devices are removed when they are no longer necessary.

2. The Contractor shall have a competent individual available to the Project to conduct the quality control program.
    a. The Contractors quality control and inspection procedures shall be subject to review by the Architect.

F. Erosion Control Schedule
   1. The Contractor shall prepare and submit a weekly schedule of proposed erosion control activities for the Architect's approval. The Architect may require schedules to be submitted orally or in writing. The schedule shall provide a discussion of:
      a. Proposed erosion control installations and when they will be installed.
      b. Areas ready for permanent turf establishment and when it will be accomplished.
      c. Grading operations and how erosion control will be incorporated into the work.
      d. Repair or maintenance required on erosion control installations and when it will be accomplished.
      e. Proposed erosion control measures during periods of suspension of work.

G. Compensation
   1. The Contractor will receive compensation for erosion control as provided for in the Contract. All other expenses incurred in complying with these provisions shall be borne by the Contractor.
      a. The Contractor will not receive compensation for erosion control off of the Project Property unless so specified in the Contract.
      b. Additional temporary and permanent erosion control measures ordered by the Project Manager, which are necessitated by additional Contract work, will be compensated by Change Order at the appropriate Contract prices for like work or as Extra Work in the absence of comparable items of work.

H. Withholding of Payment-Noncompliance
   1. If the Contractor fails to install erosion or sediment control measures ordered by the Architect, the Architect may withhold payment from related work until the control measures are undertaken by the Contractor.

   2. When the Contractor fails to conduct the quality control program, fails to conduct the inspections required in as a part of the perrmits, or fails to take action ordered by the Architect to remedy erosion or sediment control problems:
      a. The Architect will issue a written order to the Contractor.
      b. The Contractor shall respond within 24 hours with sufficient personnel, equipment and/or materials and conduct the required work or be subject to a $500.00 per calendar day deduction for noncompliance.

I. Compensation and Time Extension
   1. The Contractor will not receive additional compensation or time extensions for any disruption of work or loss of time caused by any actions brought against the Contractor for failure to comply with air, land, and water pollution controls.

3.3 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service or connect to existing service.

   1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.

   2. Provide Owner and users minimum five (5) days' notice prior to interruption of Service.

B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.

   1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.

C. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.
   1. Connect temporary water sewer service to municipal system as directed by authorities having jurisdiction.

2. Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.

D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.

F. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations, for protecting installed construction from adverse effects of high humidity, or for occupant and/or worker safety. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

G. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.
   1. Install electric power service overhead unless otherwise indicated.
   2. Connect temporary service to Owner's existing power source, as directed by Owner. Maintain equipment in a condition acceptable to Owner.

H. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.

   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

I. Telephone Service: Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

3.4 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:

   1. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.

   2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion may be permitted to use permanent facilities, under conditions acceptable to Owner.

   3. Maintain existing egress requirements and coordinate with Owner and authority having jurisdiction for temporary egress routes from existing occupied facilities as indicated and as required by authorities having jurisdiction. Coordinate with Owner for egress by Owner’s personnel.

   4. Maintain existing handicap accessibility requirements and coordinate with Owner and authority having jurisdiction for temporary handicap accessibility accommodations.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

2. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.

3. Prepare subgrade and install subbase and base for temporary roads and paved areas according to Division 31.

C. Temporary Use of Permanent Roads and Paved Areas:
1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

2. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.

3. Coordinate installation of final course of permanent hot-mix asphalt pavement with Owner. Repair hot-mix asphalt base-course pavement before installation of final course according to Division 32.

D. Traffic Controls: Comply with requirements of authorities having jurisdiction.
1. Protect existing site improvements to remain including curbs, pavement, monitoring wells, and utilities.

2. Maintain access for fire-fighting equipment and access to fire hydrants.

E. Parking: Use designated areas of Owner's existing parking areas for construction personnel.

F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction and SWPPP Plan. Maintain Project site, excavations, and construction free of water.
1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties or endanger permanent Work or temporary facilities.
2. Remove snow and ice as required to minimize accumulations.

G. **Project Signs:**

1. Temporary Signs: Provide other signs as indicated and as required to inform public, staff, and individuals seeking entrance to Project.
a. Provide temporary, directional signs for construction personnel and visitors.
b. Maintain and touch-up signs so they are legible at all times.

H. Waste Disposal Facilities

1. Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction.

I. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.

J. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.
1. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

2. Provide protective coverings, barriers, devices, signs, or other procedures to protect stairs and to maintain means of egress. If stairs become damaged, restore damaged areas so no evidence remains of correction work.

3.5 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Tree and Plant Protection:
   1. Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations.
   2. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

E. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

F. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

G. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
   1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

H. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner from fumes and noise.
   1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant-treated plywood on construction operations side.

   2. Construct dustproof partitions with two layers of 6-mil polyethylene sheet on each side. Cover floor with two layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant-treated plywood.

   3. Where fire-resistance-rated temporary partitions are indicated or are required by authorities having jurisdiction, construct partitions according to the rated assemblies.

   4. Seal joints and perimeter. Equip partitions with gasketed dustproof doors and security locks where openings are required.

   5. Protect air-handling equipment.

I. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire prevention program.
   1. Prohibit smoking in construction areas.

   2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.

3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

3.6 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
   1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
   2. Keep interior spaces reasonably clean and protected from water damage.
   3. Discard or replace water-damaged and wet material.
   4. Discard, replace, or clean stored or installed material that begins to grow mold.
   5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Enclosed Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

E. Control moisture and humidity inside building by maintaining effective dry-in conditions.

F. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.7 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.
   1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

   1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.

2. At Substantial Completion, repair, renovate, and clean permanent facilities used during construction period.

END OF SECTION 01 50 00

SECTION 01 78 39 – PROJECT RECORD DOCUMENTS

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Submittal and preparation procedures for record documents and related data. This includes but is not limited to:

1. Record as-built drawings.
2. Shop drawings, samples, approvals, substitutions and related documents.
3. Refer to section 01 79 00 for training submittals.

1.2 SUBMITTALS

A. Submittals are to include all relevant data related to the specific specification sections, as otherwise included as listed in each section, and as listed elsewhere in this section.

PART 2 – PRODUCTS

2.1 RECORD DOCUMENTS

A. Record drawings:

1. The primary contract and superintendent for the general contractor shall maintain, on a daily basis, one complete set of corrected/edited record construction documents. This set shall be marked-up and "red-lined" to include any and all variations to the drawings, including the following:
    a. Changes in dimension.
    b. Changes in location.
    c. Operational systems by manufacturer, series and model number.
    d. Changes made by change order, architect's directive or field order.
    e. Finishes, key notes and other items which otherwise modify the exactness of the documents.
2. Upon completion and submittal to the Architect, the architect shall prepare a digital copy of the record documents.
    a. The contractor shall cooperate with the Architect and furnish any missing or questionable information noted on the record documents.
    b. Submittal of the completed set by the contractor does not relieve responsibility of the correctness of the documents by the contractor.
    c. One copy shall be required of the contractor.

B. Shop drawings:

1. Contractor shall provide the owner a complete set of shop drawings for their records including, as applicable:
    a. Manufacturer's data.
    b. Charts.
    c. Samples.
    d. Warranties.
    e. Corrections, approved substitutions and changes.
    f. Other items specific to each section.

PART 3 – EXECUTION

3.1 PROCEDURES

A. Submit record documents directly to the Architect.

B. The Architect shall advise the contractor on any and all items that were not included but required. Contractor shall promptly provide missing information to the Architect for inclusion in the set of record documents.

END OF SECTION 01 78 39

SECTION 01 79 00 – DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Administrative and procedural requirements for training city staff, but not limited to:

1. Demonstration of operations of systems, subsystems and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.

1.02 SUBMITTALS

A. Submittals, including training modules, require the Commissioning Agent's review and OAR acceptance prior to implementation.

B. Instruction Program: Prior to Startup and Testing, submit a draft outline of the instructional program for demonstration and training, including the training module objectives and outline for each training module, schedule of proposed training dates, training times, length of instruction time and contractor/ instructors' names for each training module.

C. Upon completion of training, submit two complete training manuals. Each manual shall contain specific training and instruction manuals and hand-outs.

D. Attendance Record: For each training module, submit the proposed list of participants, sign in sheets and length of instruction time of the training.

E. Demonstration and Training Video: Contractor shall video record each training and demonstration session.

1.03 COORDINATION

A. Coordinate instruction schedule with all associated contractors and the owner.

B. Coordinate with instructors, including providing notification of scheduled dates, times, length of instruction time and course content.

PART 2 – PRODUCTS

2.01 INSTRUCTION PROGRAM

A. Program Structure: Develop instruction program that includes individual demonstration and training modules for the operation, maintenance, minor repair (completion in under two hours) and calibration of systems and components in the system.

B. Include description of specific skills and knowledge that participant is expected to master.

D. For each item scheduled, include instruction for the following:

1. Basis of System Design, Operational Requirements and Criteria, including, but not limited to:
    a. System, subsystem and equipment descriptions.
    b. Performance and design criteria if Contractor is delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.

h. Performance curves.

2. Documentation: Review in detail the following documentation:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project Record Documents.
   e. Identification systems.
   f. Warranties.
   g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Review, without limitation, the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.
4. Operations: Review, without limitation, the following as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for system, subsystem or equipment failure.
   j. Seasonal and weekend operating instructions.
   k. Required sequences for electric or electronic systems.
   l. Special operating instructions and procedures.
5. Adjustments : Review, without limitation, the following as applicable:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Review, without limitation, the following as applicable:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Review, without limitation, the following, as applicable:
    a. Inspection procedures.
    b. Types of cleaning agents to be used and methods of cleaning.
    c. List of cleaning agents and methods of cleaning detrimental to product.
    d. Procedures for routine cleaning.
    e. Procedures for preventative maintenance.
    f. Procedures for routine maintenance.
    g. Instruction on use of special tools.
8. Repairs: Review, without limitation, the following as applicable:
    a. Diagnostic instructions.
    b. Repair instructions.
    c. Disassembly; component removal, repair and replacement and reassembly instructions.
    d. Instructions for identifying parts and components.
    e. Review of parts needed for operation and maintenance.

PART 3 – EXECUTION

3.01 PREPARATION

A. Training Instructor: Engage qualified training instructors to instruct District's personnel to adjust, operate and maintain systems and subsystems.

B. Scheduling: Provide instruction at mutually agreed on times.

1. Schedule training with at least two weeks advance notice.

D. Demonstration and Training Video: Record each training module separately.

1. Make demonstration and testing videos at site to ensure video is representative of installed system.
    a. If requested by the Owner, as part of training, devote one lesson plan to reviewing of video to allow new employees to view the video recordings at their own convenience and be able to operate the video system without need for instructor attendance.

3.02 OPERATIONS AND MAINTENANCE MANUALS

A. Contractor shall direct Subcontractors to compile and prepare O&M Manuals and other required documentation for the equipment and systems that are provided and/or installed per their scope of work for submittal to owner prior to project closeout.

B. The owner shall receive a copy of the Operations and Maintenance manuals in prior to initiation of all demonstration and training for review and acceptance or rejection.

C. Operations and Maintenance manuals shall meet the respective requirements of Divisions 22 and 23, Division 26; and comply with the following:

1. Quantity: 2.
2. Format: 8 ½ by 11 loose leaf binders. Each binder shall be clearly labeled on the spine. Dividers shall be made of card stock with permanently marked index tabs to separate each section and sub section. Tab labels shall not be handwritten. Binders will meet other formatting requirements as outlined in DIVISIONS 02 to 49, as applicable.

3. Contents: There shall be a title page and table of contents at the beginning of each binder. The table of contents will be an outline that identifies the equipment or systems documentation

included in the binder and references the specification sections relating to the equipment and systems that are being included in each part of the binder. Each part of the binder will contain the information described below, in the following order.

a. Contractor. The first page shall contain the name, address, and telephone number of the manufacturer and installing Contractor, as well as the 24-hour number for emergency service for each piece of equipment identified in this section.

b. Preventive Maintenance Instructions. This section lists the location of preventative maintenance instructions. The list shows the piece of equipment, the Operations and Maintenance document name, and the O&M document page number that contains the instructions.

c. Submittal and Product Data. This section shall include product data not covered by manufacturer's Operations and Maintenance instructions and associated shop drawings.

d. Warranty and Service Contracts. This section shall include the following for each piece of equipment, as applicable:

1) Copy of the equipment warranty information, as applicable.

2) Additional Warranties in accordance with Warranty requirements in DIVISIONS 02 to 49, as applicable. Equipment Warranties shall clearly list requirements to maintain the Warranty in effect, conditions or acts that would invalidate or void the Warranty, and Warranty expiration date.

3) Service contracts issued. Contracts shall clearly indicate contract dates and scope of work included.

e. Operation and Maintenance Instructions. These shall be the written manufacturer's maintenance and operating instructions with the model number and features of the installed equipment or system clearly identified. This section shall include applicable data on the following:

1) Installation, startup, and break-in instructions.

2) Starting, normal shutdown, emergency shutdown, manual operation, seasonal changeover and normal operating procedures and data, including any special limitations.

3) Operations and Maintenance and installation instructions that were shipped with the unit.

4) Preventative maintenance and service procedures and schedules.

5) Troubleshooting procedures.

6) A parts list, edited to omit reference to items which do not apply to this installation.

7) A list of any special tools required to service or maintain the equipment.

8) Performance data, ratings, and curves.

f. Control Drawings. This section contains controls drawings and the final sequence of operations, set points, and schedules as set during the Commissioning Process. If shop drawings, portions of the project manual, or record drawings clearly show this information, a copy of this information may be inserted. Otherwise, original drawings must be generated and included in this section.

D. Division 23 Special Water and Air Balance Documentation. The Balancing Contractor will compile and submit the following with other documentation that may be specified elsewhere in the Project Specifications.

3.03 DEMONSTRATION AND TRAINING SCHEDULE

A. The following applies to the minimum duration of demonstration and training provided District Maintenance and Operations Personnel.

1. Heat Generation:
    a. Mechanical units.
    b. Piping, valves, related items and equipment.
    c. Pumps.
2. Refrigerant Systems:
    a. Condensers:
    b. Pumps, piping and related items and equipment.
3. HVAC Systems.
    a. Air-handling Equipment.
    b. Air Distribution Systems.
    c. Terminal Equipment and Devices.
4. Controls: HVAC related
5. Lighting Systems and Controls.
6. Equipment:
    a. Lifts
    b. Cranes
    c. Lube equipment
    d. Specialty equipment
    e. Other equipment and operational items which have moving components.

END OF SECTION 01 79 00

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SECTION 02 40 00 – DEMOLITION AND SITE CLEARING

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY:

A. Section includes demolition of the existing building and related sitework that are required to be removed, as indicated on drawings and specified herein, and as summarized below.

B. Carefully demolish and dispose of, off site, all unwanted and defective building materials, which are to be removed for the installation of new work, including all walls, floors, built-in items, footings, steel, concrete, earthwork, finishes, doors, glazed openings and related items as noted on the demolition plan.

C. This section also includes any shoring and bracing, along with protections, that may be required during demolition operations.

D. Section also includes a minor amount of site clearing in order to help establish new grades and a building pad for the new work.

E. As applicable, in advance of the demolition work, contact Gopher 1 and the city authority to locations buried utilities. This includes any city provided buried lines that would not otherwise be covered by Gopher 1, such as phone, fiber and other light duty items.

F. Confer with the Owner and County in advance of the demolition work to assure that any underground utilities which are currently on site and included within the property are identified.

G. The work includes identifying and protecting some existing underground utilities, any necessary capping off of utilities and coordination with local authorities, utility companies and appropriate contractors. Contractor shall obtain all necessary permits. If Contractor causes any damage to the existing utilities, the repair of the work shall be performed by the contractor at no cost to the Owner.

H. It is expected that there will be no materials or building components within the scope of work that will be saved and retained: refer to drawings and notes in the section. Once the work begins, it is assumed that the Owner has removed all items to be re-used that would otherwise be demolished.

I. Any hazardous materials have been removed and abated prior to the start of general demolition activities. Should the contractor encounter any questionable materials, stop the work, confer with the owner’s PM and wait for further direction.

J. Refer to other Division 01 sections, and other civil sections, for Gopher One requirements as they apply to this work

1.3 SUBMITTALS:

A. Schedule: Prior to the start of any demolition work, submit schedule indicating proposed methods and sequence of operations for selective demolition work to Architect and Owner's Representative for review prior to commencement of work. Include coordination for shut-off, capping, and continuation of utility services as required, together with details for dust and noise control protection.

1.4 QUALITY CONTROL:

A. Prior to start-up of demolition work, the general contractor shall schedule a preconstruction meeting between Owner, Architect, demolition contractor, and all sub-contractors that have a related interest including mechanical, electrical, concrete, steel, carpentry and other contractors. Staging, service, Owner's use of site, lead items, shoring, temporary facilities, signage, and all other necessary items shall be addressed. Contractor shall take minutes of the meeting and distribute them to all persons present.

1.5 JOB CONDITIONS:

A. Damages: Promptly repair damages caused to adjacent materials by demolition work at no cost to Owner.

B. Traffic: Conduct demolition operations and debris removal in a manner to ensure minimum interference with users of the building.

C. Provide signage, updated on a daily basis if necessary, to advise the public and staff of entries to the office space, hazardous areas and construction zone. Signage shall be professionally made type with black letters on white or yellow background. The minimum height of the letters shall be 8" in height. Include arrows, symbols and graphics as necessary.

D. At the end of each work day, ensure that building is enclosed and secure through temporary walls and construction.

E. Explosives: Use of explosives will not be permitted.

F. Utility Services: Maintain existing utilities indicated to remain, keep in service, and protect against damage during selective demolition and construction operations.

1. Do not interrupt existing utilities serving occupied or used facilities, except when authorized in writing by authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to governing authorities.

G. Environmental Controls: Use water sprinkling, temporary enclosures, and other suitable methods to limit dust and dirt rising and scattering in air to lowest practical level. Comply with governing regulations pertaining to environmental protection.

1. Do not use water when it may create hazardous or objectionable conditions such as ice, flooding, and pollution.
2. Perform demolition work in such a manner as to prevent all fires. Burning on the site will not be permitted.
3. Instruct workers in the use of fire protection equipment and safety procedures.

PART 2 - PRODUCTS (Not Applicable).

PART 3 - EXECUTION

3.1 INSPECTION:

A. Prior to commencement of demolition work, inspect areas in which work will be performed. Photograph existing conditions to structure surfaces, equipment or to surrounding properties which could be misconstrued as damage resulting from demolition work; file with Owner's Representative prior to starting work.

3.2 PREPARATION:

A. Locate, identify, cap off and disconnect utility services that are not indicated to remain.

B. Identify items to be saved, and carefully removed and stored.

3.3 DEMOLITION:

A. Perform demolition work in a systematic manner. Use such methods as required to complete work indicated on Drawings in accordance with demolition schedule and governing regulations.

B. If unanticipated mechanical, electrical or structural elements which conflict with intended function or design are encountered, investigate and measure both nature and extent of the conflict and contact Architect.

C. Do not use demolished or salvaged materials unless specified or approved in writing by the Owner or Architect at the beginning of the project.

3.4 DISPOSAL OF DEMOLISHED MATERIALS:

A. Remove debris, rubbish and other materials resulting from demolition operations from building site. Transport and legally dispose of materials off site. Refer to Section 017419 for additional information.

1. If hazardous materials are encountered during demolition operations, notify Owner immediately. If allowed to continue, comply with applicable regulations, laws, and ordinances concerning removal, handling and protection against exposure or environmental pollution. Burning of removed materials is not permitted on project site.

3.5 CLEAN-UP AND REPAIR:

A. Upon completion of demolition work, remove tools, equipment and demolished materials from site. Remove protections and leave interior areas broom clean.

B. Repair adjacent materials soiled or damaged by demolition work.

END OF SECTION 02 40 00

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SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes concrete work: cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, finishes, trench drain installation and other embedded items as shown on drawings, specified herein, including footings, floor slabs, infill slabs, maintenance curbs, aprons, stoops and miscellaneous items within and directly adjacent to the building. Refer to the structural drawings for slab thicknesses, details and special items. In general, the work includes the following:

Footings

Stoops (at doors)

Aprons (at overhead doors, including concrete infill between stoops and aprons)

Cast-in-place concrete work

Interior slabs on grade

Vapor retarder (barrier)

Masonry grout.

B. Section 32 13 13 includes Site Concrete: curb, gutter, walkways, sidewalks, and standard exterior site concrete only.

C. Trench drains for the typical floors are specified in the mechanical section.

D. By code, a vapor retarder is required directly below all of the concrete slabs in the building – see drawings for building sections.

E. The scope of work includes in-floor heat at portions of the building. Coordinate the concrete work with the mechanical contractor ahead of installation of insulation and tubing to assure that all the work is performed and executed correctly.

F. Contractor of this section shall work with the testing agency hired by the Owner, including contacts, assistance and compliance with directives by the field engineer.

G. Work in this section shall not proceed prior to a preconstruction meeting for flatwork as noted in Quality Assurance paragraph below. Footings may proceed without this meeting. **Architect must be given a minimum one -week notice before the meeting can be scheduled: No exceptions.**

H. Work includes sealing / curing compounds as a part of the work. If the prime contractor of this section is not experienced with successful installations of these products, they shall contract with an installer that can achieve satisfactory results.

1.3 RELATED WORK

Section 31 10 00, Earthwork
Section 32 13 13, Site Concrete
Section 07 92 00, Joint sealants
Division 23 for heating related specifications.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. At least 7 days prior to first pour, submit all mix designs proposed for use on the project. Provide all necessary information, including the location of the proposed mix designs and a complete standard deviation analysis or trial mix test data.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

1.5 INFORMATIONAL SUBMITTALS

A. Floor surface flatness and levelness measurements.

1.6 QUALITY ASSURANCE

A. Codes and Standards: Comply with the latest edition of the following codes and standards except where more stringent requirements are shown or specified:
1. MN Building Codes and MnDOT Standards MnDOT 2461
2. ASTM E1155 “Standard Method for Determining Floor Flatness”
3. ACI 301 “Specifications for Structural Concrete for Buildings”
4. ACI 318 “Building Code Requirements for Reinforced Concrete”
5. Concrete Reinforcing Steel Institute: “Manual of Standard Practice”

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.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: Owner shall retain an independent agency**,** qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

D. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete.”

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

E. Concrete Testing Service: Owner shall engage and pay for a testing laboratory to perform material evaluation tests. The contractor is required to coordinate all testing work with the agency. **Contractor shall pay** for all failed tests and necessary additional testing, at no cost to the Owner, as determined by the Architect, in the event that preliminary testing shows failure of the Contractor to meet specifications.

F. **Mandatory** Pre-installation Conference: Prior to, or concurrent with, the submittal of design mixes, the Contractor shall arrange a meeting with Owner, Architect, ready-mix supplier representative, concrete sub-contractor and all other associated contractors and suppliers. Discussion shall include proper use of admixtures, proper placement of concrete, curing methods, concerns of weather conditions, timing and all other concerns. Contractor shall be responsible for taking minutes of the meeting and distribute them to all parties present, and shall arrange this meeting a **minimum of one week** in advance of any pours (although footings can proceed prior to this meeting. The minutes shall include a statement by the concrete contractor indicating that the proposed mix design(s), and placing, finishing and curing procedures can produce the concrete quality required by these specifications.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels made especially for this purpose that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete (only for concrete surfaces which will be unexposed in finish structure): Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.2 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed; ties and stirrups must be grade 60.

1. Epoxy-Coated Reinforcing Bars: ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inchbar length.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, plain, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497/A 497M, flat sheet.

D. Epoxy-Coated Welded Wire Reinforcement: ASTM A 884/A 884M, Class A coated, Type 1, steel.

E. 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.

2.3 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, gray. Only one brand of cement shall be used.

    a. Fly Ash: ASTM C 618, Class C, NSP Power Plant or approved equal, limited to 25% of cement content by weight at footings and 20% at all other concrete.

2. Blended Hydraulic Cement: ASTM C 595, type IS, type IP, type I (PM), type I (SM) cement.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 1-1/2” nominal at footings and slabs, 3/8” nominal at masonry concrete infill, 3/4" at all other locations (unless shown otherwise in structural drawings).

2. Minimum total coarse aggregate content for slabs on grade and topping slabs shall be 12 cubic feet per cubic yard for 1 ½” or larger top size aggregate; 11.5 cubic feet per cubic yard for top size aggregate 1 ¼” or larger but less than 1 ½”; 11 cubic feet per cubic yard for topsize aggregate 1” or larger but less than 1 ¼”; or 10.5 cubic feet per cubic yard for topsize aggregate less than 1”.[1]

3. Combined aggregate gradation for slabs on grade, topping slabs, and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller topsize aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100. [1]

4. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable. **There shall be no site-water used on site at this project**, provide superplasticizer for desired slump.

2.4 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 (superplasticizer): ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture (superplasticizer): ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

Note: Superplasticizer shall be used in all interior flatwork and any pumped concrete unless otherwise approved in writing by the Architect. All concrete with a W/C of 0.48 or less, and where pumping equipment is used, requires this admixture. In general, concrete shall be delivered to the site with a slump of 3" to 3-1/2". Admixture shall be site added in lieu of any additional water.

2.5 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III. To be used in unison with macro synthetic fibers, reinforcing steel, or in non-reinforced concrete slabs, but shall not be considered as a replacement for WWF or reinforcing steel of any kind.

1. Products:
   a. Monofilament Fibers:
      1) Euclid Chemical Company (The); Fiberstrand 100.
      2) FORTA Corporation; Forta Mono.
      3) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
   b. Fibrillated Fibers:
      1) Euclid Chemical Company (The); Fiberstrand F.
      2) FORTA Corporation; Forta.
      3) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
      4) SI Concrete Systems; Fibermesh.

B. Structural Synthetic Macro Fiber Reinforcement:Complying with ASTM C 1116, minimum of 2 inches (50 mm) length, aspect ratio of 50 to 90, providing a minimum average residual strength of 200 psi at a nominal dosage rate of 4 lbs per cubic yard per ASTM C 1399. In addition fiber manufacture shall be able to provide U.L. certification indicating 2 hour maximum fire resistance when used in lieu of WWF in U.L. rated floor ceiling D700, D800, and D900 Series Designs.

1. Products.
   a. Euclid Chemical Company (The); Tuf-Strand SF.[1]

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder (vapor barrier): Polyethylene sheet, ASTM D 4397, not less than 10 mils thick. Include manufacturer's recommended adhesive or pressure-sensitive tape.

2.7 CURING AND COATING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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 special coating: At the **office / vehicle / shop areas**, where the concrete floor remains exposed to view, provide liquid densifier and sealer: Euco Diamond Hard (Euclid Chemicals), in thickness and coats as recommended by the manufacturer.

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).

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

B. Repair Topping: If required and accepted by the Architect for minor repairs, provide self-leveling polymer modified high strength topping.

C. Bonding Compound: Acrylic polymer modified type, non-rewetable bonding compound.

D. Epoxy Adhesive: Two-part, 100% solids, 100% reactive compound suitable for dry or damp surfaces, ASTM C 881.

2.9 EMBEDDED ITEMS:

A. Refer to mechanical specifications for trench drains that will be used on this project, furnished by the mechanical contractor and installed as a part of this section.

2.10 CONCRETE MIXTURES

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. Use an independent testing facility acceptable to Architect.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 25 percent.[1]

C. Admixtures: Use admixtures in strict compliance with manufacturer's written instructions. Revise three subparagraphs below to suit Project; delete if not required.

1. Use water-reducing, retarding, accelerating, or plasticizing admixtures in concrete, as required, for placement and workability. Use a non-corrosive, non-chloride accelerator in slabs placed below 50 degrees F.
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. Provide **air entrainment at all** exterior concrete which is a part of this section, including aprons, at a rate of 6% +/1%.
5. Provide superplasticizer at all flatwork, pumped concrete, architectural concrete and as necessary to achieve the specified strengths, water-cement ratios or other items.
6. Ready-Mix Materials: Comply with ASTM C 94. Contractor shall reject all concrete brought in by ready-mix truck that exceeds maximum allowable slumps and water-cement ratios, and the following limits:

   60 minutes after inclusion of superplasticizer.
   60 minutes for all concrete in temperatures exceeding 80 degrees.
   90 minutes for all other concrete.
   Re-tempering of Concrete is not allowed.[1]

D. Proportion normal-weight concrete mixture as follows:

Use at: Stoops, aprons and other concrete subject to cold weather.

1. Minimum Compressive Strength: **4000 psi** at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **.46**
3. Slump Limit: **5 inches** for concrete (with verified slump of **2 to 4 inches** before adding high-range water-reducing admixture or plasticizing admixture) plus or minus **1 inch**.
4. Air Content: **6 percent**, plus or minus 1 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

5. Structural Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4lb/cu. yd.

E. Proportion normal-weight concrete mixture as follows:

Use at: Interior concrete, topping slabs and slabs on grade.

1. Minimum Compressive Strength: **4000 psi** at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **.46**
3. Slump Limit: 4 **inches** prior to the addition of superplastisizer.
4. Use 3/8" aggregate at topping slabs.
5. Air Content: **Non-air entrained.**
6. Straight Type 1 Portland cement.
7. Synthetic Micro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than **1.5 lb/cu. yd.**

F. Proportion normal-weight concrete mixture as follows:

Use at: Footings

1. Minimum Compressive Strength: **3000 psi** at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **.50**
3. Slump Limit: **4 inches** for concrete, plus or minus **1 inch**.
4. Air Content: Non-air entrained.

G. Proportion normal-weight concrete mixture as follows:

Use at: Masonry grout

1. Minimum Compressive Strength: **3000 psi** at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **.650**
3. Slump Limit: **6 inches** for concrete, plus or minus **1 inch**.
4. Air Content: Non-air entrained.

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 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 GENERAL

A. All steel reinforcement installation shall be performed by certified Iron Worker labor classification.

3.2 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.

C. Chamfer exterior/exposed corners and edges as indicated, of permanently exposed concrete.

D. Design formwork to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust stained formwork is not acceptable.

E. Construct forms to sizes shapes, lines and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Conform to ACI 347. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide backup at joints to prevent leakage of cement paste.

F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.

G. Provide temporary openings where interior area of formwork is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.

H. Provisions for Other Trades: Provide openings in concrete formwork to accommodate work of other trades. Determine size and location of openings, recesses and chases from trades providing such items. Accurately place and securely support items built into forms. Coordinate with all other trades.

I. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt or other debris just before concrete is placed. Retighten forms and bracing after concrete placement is required to eliminate mortar leaks and maintain proper alignment.

Rust and scale on any formwork shall not be acceptable.

3.3 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.

3.4 VAPOR RETARDERS

A. Below Grade Vapor Retarder Installation:
   1. Install reinforced vapor retarders in accordance with manufacturer's instructions and ASTM E 1643 at concrete slabs.
   2. Install Vapor Retarder continuously at locations as indicated on the drawings. Ensure there are no discontinuities in vapor retarder at seams and penetrations.
   3. Install vapor retarder in largest practical widths.
   4. Lap joints minimum 6 inches and seal with manufacturer's recommended tape.
   5. Ensure surface beneath vapor retarder is smooth with no sharp projections.
   6. Join sections of vapor retarder and seal penetrations in vapor retarder with mastic tape. Ensure vapor retarder surfaces to receive mastic tape are clean and dry.
   7. Immediately repair holes in vapor retarder with self-adhesive tape
   8. Seal around pipes and other penetrations in vapor retarder with pipe boots in accordance with manufacturers recommendations.

3.5 STEEL REINFORCEMENT

A. Reinforcement shall be accurately placed in accordance with shop drawings and securely tied at intersections with 16 gauge black annealed wire, and shall be maintained in proper position by chairs, bar supports, or other approved devices.

B. Clear distance between bars shall be not less than 1-1/2", 1-1/2 bar diameters, nor less than 1-1/2 times the maximum size of coarse aggregate.

C. Concrete protection of reinforcing shall be not less than the following:
   1. 3" where concrete is poured against soils.
   2. 2" where concrete is poured against forms but may be in contact with soils.
   3. 1-1/2" minimum in exterior face of exterior walls (exposed to weather but not in contact with soils).
   4. Wherever conduits, piping, inserts, sleeves, etc., interfere with the placing of reinforcing steel as shown or called for, the Contractor must consult with the Architect/Engineer and secure from him the method of procedure before pouring any concrete.
      a. No bending or field cutting of bars around openings or sleeves will be permitted without approval of the Architect/Engineer
   5. Bars shall lap 30 diameters at splices unless otherwise indicated.
      a. Splices in adjoining horizontal bars shall be staggered wherever possible.
      b. Horizontal bars shall be hooked around corners not less than 32 diameters, with a minimum of 16" as per typical details.

D. Refer to structural drawings and notes for additional details.

3.6 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. If not shown otherwise, at construction joints provide dowels with smooth 5/8" diameter by 2'-0" length @ 12" on center, with one end greased. Ensure dowels are inserted level and square as to not impart any stress or dovetailing. Use dowels that have been properly made or cut to avoid burrs and raised ends.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated, with a maximum joint spacing of 36 times slab thickness at any area. Construct

contraction joints for a depth equal to at least 1/4 of concrete thickness as follows (unless indicated otherwise):

1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Use soft-cut early entry saw to cut 1/8-inchwide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

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.

E. Refer to structural drawings and notes for locations and additional details.

3.7 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms and base materials immediately before placing concrete where form coatings are not used.

B. Notify Architect at least 2 days in advance of each major concrete pour. There shall be no excuses for the lack of notice, unless the pour is called off due to weather.

C. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

D. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Do not permit concrete to drop more than five feet from its point of release. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

E. 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. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

F. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.

G. Placing Concrete Slabs: Just prior to placement, dampen all areas of the base material. Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.

H. At areas of the building which have slabs over 4” thick, bring slab surface to initial correct level by means of laser screed. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.

I. Bring slab surfaces to correct level with straightedge and strikeoff highway straightedge at all flatwork with tolerance of F 20 or less. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Laser screeds may be required for placement in areas where flatness specifications are greater.

J. Minimum Cover: Maintain coverage of reinforcement as shown on the structural drawings.

K. Cold-Weather Placement: Comply with ACI 306.1 and as herein specified.

L. Hot-Weather Placement: Comply with ACI 301 and as herein specified.

M. Hot Weather Placement: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

N. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

O. Fog spray forms, reinforcing steel and subgrade just before concrete is placed. During and after placement, provide fog spray over, but not directly on concrete.

P. Concrete shall not be retempered. Discard concrete that has obtained its initial set.

Q. Site water shall not be added. If workability is desired, add superplasticizer on site as specified.

R. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

S. Cool ingredients before mixing to maintain concrete temperature at time of placement. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

T. Cold Weather Placement: Comply with ACI 306. When air temperature is expected to fall below 40 degrees, uniformly heat all mixing ingredients. Provide protection as required when overnight temperatures are expected to drop below 34 degrees. Do not use any materials that are frozen. Cover slabs and exposed concrete as required through below freezing temperatures at all times. If temperatures drop below 26 degrees, re-schedule placement until weather permits.

U. Concrete shall be in mixer no more than the maximum specified. Trucks shall be ordered to return to the plant, with the load rejected if concrete exceeds this condition.

3.8 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 not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to be covered with a coating or covering material applied directly to concrete.

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, re-straightening, 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 to receive concrete floor toppings, and at areas to receive mortar setting beds for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Re-straighten, cut down high spots, and fill low spots. Repeat float passes and re-straightening until surface is left with a uniform, smooth, granular texture.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by power-driven trowel. Continue troweling passes and re-straighten 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 exposed to view, or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic, porcelain or quarry tile is to be installed by either thickset or thin-set method. While concrete is still plastic, slightly scarify surface with a fine broom.

F. Broom Finish: Apply a broom finish to areas that are required: verify this in advance with Architect/owner **prior to placing concrete.**

G. Levelness and flatness:

1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane so that depressions between high spots do not exceed F_F20 - F_L20. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

2. After floating, begin first trowel finish operation using a power- driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with a level surface plane so that depressions between high spots do not exceed tolerances listed below. Grind smooth defects which would telegraph through applied floor covering system only if acceptable to Architect.

Finishing Tolerances: All locations except as noted:
Specified overall $F_F = 50$
Specified overall $F_L = 35$
Specified local $F_F = 30$
Specified local $F_L = 20$

3.10 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. 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 ten[1]days.

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 ten[1] days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture Retaining Fabric shall be installed in accordance with manufacture’s written recommendations, in largest practical widths. Wet the slab to rejection then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum 18”. Weight all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.[1]

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 **unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project**.

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.[1]

3. Removal of moisture retaining cover.

    a. After minimum 10 day cure, remove moisture retaining cover in sections of maximum of 3,500 square feet of concrete curing cover may be removed at any one time. At no time shall the exposed area be permitted to dry prior to completion of the floor scrubbing process described below.

b. Using a powered floor scrubber capable of a minimum 80 pounds head pressure, and a mild citrus based detergent that does not damage or mar the surface in any way, scrub the floor to remove any minerals or soluble salts that may have accumulated at the floor surface. Rinse area thoroughly with clean fresh water. Remove water and allow floor to dry. If whitening occurs during drying, repeat scrubbing process before floor dries until no whitening occurs during drying.

c. All areas of the floor shall remain wet during floor scrubbing process. Expose only the amount of floor surface that can be cleaned before any drying occurs without exceeding the maximum allowable exposed area.[1]

3.11 REMOVAL OF FORMWORK:

A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50°F (10°C) for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

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. Note: Backplastering or troweling a cementitious cover over defective areas of exposed concrete greater than 10 square inches shall not be acceptable. Remove and replace defective concrete as otherwise specified.

Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Architect. It shall be up to the Architect if inferior areas of the work shall be replaced rather than repaired: verify with the Architect before proceeding. When areas are to be replaced they shall be done so within the area up to the nearest control or expansion joint.

3.13 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Refer to the Structural drawings, “General Structural Notes” for Special Inspection requirements.

C. Testing: Owner shall pay for sampling and testing for quality control during placement of concrete and masonry grout shall include the following, as directed by Architect.

D. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

E. Slump: ASTM C 143; one test at point of discharge for each truck. Test shall be at the initial pour and middle of pour.

F. Air Content: ASTM C 173, volumetric method for normal weight concrete; ASTM C 231 pressure method for normal weight concrete; as applicable, one for each day's pour of each type of air entrained concrete.

G. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders (3 to be used and one for reserve) for each compressive strength test, at 7 / 28 days, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required.

Frequency of testing shall comply with ACI 318. Record temperature each time a set of compression test specimens are made.

H. Test results will be reported in writing to Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

I. Testing Engineer or job superintendent shall reject the load if slump, water/cement ratio, air content or related specified requirements are not met. Notify Architect immediately of such conditions.

J. Additional Tests: Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

K. Flatness Testing: Testing of floor tolerance to verify F_f and F_l according to ASTM E 1155 may be carried out at owner's expense if requested by owner. A report will be submitted to contractor and owner/architect within 48 hours of testing.

END OF SECTION 03 30 00

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SECTION 05 12 00 - STRUCTURAL STEEL

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Structural steel is that work defined in American Institute of Steel Construction (AISC) "Code of Standard Practice" and as otherwise shown on drawings.

1. Steel tubes and pipes
2. Steel beams
3. Angles, plates, base plates and related items
4. Bolts, fasteners and related components
5. Welding accessories

1.4 SUBMITTALS

A. Shop Drawings: Complete details of each member and connection, schedules and erection plans. The structural drawings shall not be used as erection plans.

B. Certificate of compliance: Reference structural drawings for special inspection criteria.

C. Submit delegated design documents provided by the fabricator which are prepared and signed by an engineer registered in the State of Minnesota.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Comply with current provisions of following, except as otherwise indicated below:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges".

   a. Paragraph 4.2.1 of the above code is hereby modified by deletion of the following sentence: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings".

2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including the "Commentary" and Supplements thereto as issued.

3. AISC "Specifications for Architecturally Exposed Structural Steel".

4. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts" approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.

5. AISC "Manual of Steel Construction - Allowable Stress Design."

6. American Welding Society (AWS) D1.1 "Structural Welding Code - Steel".

7. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".

B. Design of Members and Connections: Details shown are typical; similar details apply to similar conditions, unless otherwise indicated. Verify dimensions at site whenever possible without causing delay in the work and promptly notify Engineer/Architect of inconsistencies.

C. Fabricator and erector qualifications: both fabricator and erector shall have a minimum of five successful years of experience in fabricating and erecting steel consistent with the work of the project. The Architect shall retain the ability to request references of either or both sub-contractors prior to the start of the work.

D. Delegated design documents shall be prepared and signed by an engineer licensed in the State of Minnesota.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to site at such intervals to insure uninterrupted progress of work.

B. Deliver anchor bolts and anchorage devices, which are to be embedded in cast-in-place concrete or masonry, in ample time to not to delay work.

C. Store materials for easy access and inspection. Provide shores or blocking to prevent any part of the steel from touching ground.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: Use materials which are smooth and free of surface blemishes.

B. Structural Plates, Angles, Channels and Bars: ASTM A 36.

C. Structural Wide Flange Steel: ASTM A 992.

D. Cold-Formed Hollow Structural Sections: ASTM B 500, Grade B, Fy=46 KSI.

E. Steel Pipe: ASTM A 53, Type E, Grade B; Fy=35 KSI.

F. Steel Castings: ASTM A 27, Grade 65-35, medium-strength carbon steel.

G. Headed Stud-Type Shear Connectors: ASTM A 108, Grade 1015 or 1020, cold finished carbon steel; with dimensions complying with AISC Specifications. Furnish 3/4" diameter studs unless otherwise noted.

H. Anchor Bolts: ASTM A 307 or ASTM F1554 Grade 36, non-headed type unless otherwise indicated.

I. High-Strength and Tension Control Threaded Fasteners: ASTM A 325, heavy hexagon structural bolts, heavy hexagon nuts, and hardened washers.

J. Electrodes for Welding: Comply with AWS Code, E70XX, unless otherwise noted on plans.

K. Non-Metallic Shrinkage-Resistant Grout: Refer to Section 03 30 00, Concrete for material and acceptable manufacturers.

L. Primer: Manufacturer's standard red or grey primer at all exposed surfaces. Provide touch-up repair primer at surfaces that have been welded or marred.

M. Grout: For base plates, provide non-shrink 4000 psi grout complying with ASTM C 1007.

2.2 FABRICATION

A. Shop Fabrication and Assembly: Shop fabricate to greatest extent possible. Properly mark and match-mark materials for field assembly expeditious field handling and assembly.

B. Connections: Weld or bolt shop connections, as indicated. Fabricator shall design shop and field connections unless detailed on the drawings. Use standard connections shown in ASIC "Manual" wherever possible.

C. Welded Construction: In accordance with AWS Code.

D. Shear Connectors: Per manufacturer recommendations. Use automatic end welding of headed stud shear connectors.

E. Holes for Other Work: Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame cut holes or enlarge holes by burning. Drill holes in bearing plates.

PART 3 - EXECUTION

3.1 ERECTION

A. Temporary Shoring and Bracing: Provide temporary shoring and bracing members with connections as required. Remove only after permanent members are in place and final connections are made.

B. Temporary Planking: Provide temporary planking and working platforms as necessary to effectively complete work.

C. Setting Bases and Bearing Plates: Clean and prepare concrete and masonry bearing surfaces, and bottom surface of base and bearing plates. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices. Support structural steel bearing on masonry walls on a full bed of mortar.

D. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.

E. Do not load structural frame until all bolted and welded connections have been completed. Steel Foreman shall personally inspect all connections prior to installation of joists and deck.

F. Pack grout solidly so that no voids remain, and in accordance with manufacturers' instructions.

G. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming a part of a complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces which will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment. Do not cut or enlarge holes without written approval by the Engineer.

H. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when completed and in service. Splice members only where indicated and accepted on shop drawings.

I. Erection Bolts: On exposed welded construction, remove erection bolts, fill holes with plug welds and grind smooth at exposed surfaces.

J. Erect work in accordance with AISC Specifications.

3.2 FIELD QUALITY CONTROL

A. Owner shall engage an independent testing and inspection company to inspect work, perform tests and prepare test reports, including those items listed below. Refer to Special Inspection Requirements on the Structural Drawings.

B. Correct deficiencies in structural steel, whether discovered by regular inspection, special inspections, or punch list review. Additional tests shall be performed as necessary, and paid for by the Contractor, until full compliance is achieved.

C. Bolted Connections: Inspect or test in accordance with AISC specifications.

D. Welded Connections: Include visual inspection of welds, ultrasonic testing of all penetration welds, and shear connection testing in accordance with AWS D1.1.

END OF SECTION 05 l2 00

SECTION 05 50 00–MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

1. Miscellaneous steel framing and supports.
2. Pipe bollards.
3. Steel access ladders/stairs.
4. Hand railings and guard rails.

B. Rails: Provide the following for the railings:

1. Posts for rails shall include bottom plate for fastening to wood structure.
2. Include closing mechanism at the mezzanine gates at contractor’s choice. (These can be movable oversized pipe sections approximately 12” long with through-bolt on one end.)

C. Refer to mechanical specifications for trench drains.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated; to be designed, fabricated, and installed in accordance with current code requirements.

B. Structural Performance of Handrails and Railing Systems: Comply with ASTM E 985, and ASTM E 894 and E 935 (for testing).

C. Structural Performance: Design, engineer, fabricate, and install in accordance with the following:

D. Guardrail Systems: Concentrated load 300 lbf applied at any point. Uniform load 100 lbf per linear ft.

E. Treads of Steel Stairs: Uniform load of 100 lbf per sq.ft. or a concentrated load of 300 lbf on a area of 4 sq. inches located in the center of the tread, whichever produces the greater stress.

F. Platforms of Steel Stairs: Capable of withstanding a uniform load of 100 lbf per sq. ft.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

1.4 SUBMITTALS

A. Shop Drawings: Provide submittals in accordance with the provisions of Section 01 3300. Show fabrication and installation details for metal fabrications.

B. Shop Drawings showing fabrication and installation of each metal fabrication. Include plans, elevations, sections, and details of metal fabrications and their connections, anchorage, and accessory items.

C. Templates for anchors and bolts installed under other Sections; furnish to those responsible for installation.

D. Structural calculations, material properties, and other information for systems that have loading requirements. Structural calculations to be certified by a Professional Engineer licensed by the State of Minnesota.

E. Welder qualification certificates signed by the Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article.

F. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces without blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Steel Tubing: ASTM A 500, cold-formed steel tubing.

C. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

D. Wire Rod for Grating Cross Bars: ASTM A 510.

E. Uncoated Structural Steel Sheet: Product type (manufacturing method), quality, and grade, as follows:

1. Cold-Rolled Structural Steel Sheet: ASTM A 611, grade A.

F. Uncoated Steel Sheet: Commercial quality, product type (method of manufacture) as follows:

1. Cold-Rolled Steel Sheet: ASTM A 366.

G. Gray Iron Castings: ASTM A 48, Class 30.

H. Malleable Iron Castings: ASTM A 47, grade 32510.

I. Brackets, Flanges and Anchors: Cast or formed metal of the same type material and finish as supported rails, unless otherwise indicated.

J. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron, ASTM A 47, or cast steel, ASTM A 27. Provide bolts, washers, and shims as required, hot-dip galvanized per ASTM A 153.

K. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for the metal alloy to be welded.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 or Type 316, as required, stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, at exterior walls.

B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel is Indicated: Alloy Group 1 or Group 2, as required, stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

C. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, minimum 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

D. Bolts and Nuts: Regular hexagon head type, ASTM A 307, Grade A.

E. Lag Bolts: Square head type, FS FF-B-561.

F. Machine Screws: Cadmium plated steel, FS FF-S-92.

G. Wood Screws: Flat head carbon steel, FS FF-S-111.

H. Plain Washers: Round, carbon steel, FS FF-W-92.

I. Drilled-In Expansion Anchors: Expansion anchors complying with FS FF-S-325, Group VIII (anchors, expansion, [nondrilling]), Type I (internally threaded tubular expansion anchor); machine bolts complying with FS FF-B-575, Grade 5.

J. Toggle Bolts: Tumble-wing type, FS FF-B-588, type, class, and style as required.

K. Lock Washers: Helical spring type carbon steel, FS FF-W-84.

2.4 MISCELLANEOUS MATERIALS

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

C. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

D. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Use connections that maintain structural value of joined pieces.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges. Remove sharp or rough areas on exposed surfaces.

C. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance 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.

D. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Locate joints where least conspicuous.

E. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Fabricate gates to sizes as shown on drawings. Include required hinges, stops, keepers and closers.

G. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors not less than 24 inches o.c., as required by manufacturer, or as indicated in drawings (most stringent applies).

H. Provide all metal and steel products as shown on the drawings and as required for completion of all the work, that are not included in other sections within this specification. The following subcategories are listed as a general guide for fabricating common components on this project.

I. Provide steel railings and handrails as indicated on the drawings.

1. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of pipe.

2. Provide wall returns at ends of wall-mounted handrails, unless otherwise indicated.

3. Close exposed ends of pipe with welding 3/16" thick plate.

4. Toe Boards: Provide toe boards at railings around openings and at the edge of open-sided floors and platforms. Fabricate to dimensions and details indicated, or if not indicated, use 4 inches high x 1/8 inch steel plate welded to, and centered between, each railing post.

5. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, end closures, flanges, miscellaneous fittings, and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

6. For exterior steel railings and handrails formed from steel pipe with galvanized finish, galvanize fittings, brackets, fasteners, sleeves, and other ferrous components.

7. Provide anchors for embedding units in concrete, either integral or applied to units, as standard with the manufacturer.

8. Apply black asphaltic coating to concealed bottoms, sides, and edges of cast-iron units set into concrete.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

2.7 MISCELLANEOUS STEEL TRIM AND PLATE

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible. Fabricate steel plate at overhead door openings of continuous bent shape as indicated on drawings.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

C. Galvanize all miscellaneous steel trim.

D. Prime miscellaneous steel trim with primer, use zinc-rich primer on galvanized trim.

2.8 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 80 steel pipe to extend a minimum of 3’-8” below grade. Weld ½”x 3” (8) headed studs to bollard at embedment level.

B. Fabricate sleeves for bollard anchorage from steel pipe or tubing with 1/4-inch thick steel plate welded to bottom of sleeve.

C. Prime bollards with zinc-rich primer.

3.0 STEEL FRAMED STAIRS

A. General: Weld stair pieces to conform to sizes and arrangements indicated, including all metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.

B. NAAMM Stair Standard: Comply with commercial class "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.

C. Stair Framing: Fabricate stringers of structural steel channels, or plates, or a combination thereof, as indicated. Provide closures for exposed ends of stringers. Construct platforms of structural steel channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.

D. Where masonry walls support steel stairs, provide temporary supporting struts designed for erection of steel stair components before installation of masonry.

E. Metal Pan Risers, Subtreads, and Subplatforms: Shape metal pans for risers and subtreads to conform to configuration shown. Provide thicknesses of structural steel sheet for metal pans indicated, but not less than that required, to support total design loading.

F. Form metal pans of uncoated cold-rolled steel sheet, unless otherwise indicated.

G. Attach risers and subtreads to stringers by means of brackets made of steel angles or bars. Weld brackets to stringers and attach metal pans to brackets by welding, riveting or bolting.

H. Provide subplatforms of configuration and construction indicated; if not indicated, of same metal as risers and subtreads, in thicknesses required to support design loading. Attach subplatform to platform framing members with welds.

I. Smooth Soffit Construction: Construct subplatforms with smooth soffits.

J. Steel Floor Plate Treads and Platforms: Provide raised pattern steel floor plate in pattern indicated or, if not indicated, as selected from manufacturer's standard patterns.

K. Form treads of 1/4 inch thick raised pattern steel floor plate with integral nosing and back edge stiffener. Weld steel supporting brackets to stringers and treads to brackets.

L. Fabricate platforms of raised pattern steel floor plate of thickness indicated. Provide nosing matching that on treads at all landings. Secure to platform framing members with welds.

M. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

2.9 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish metal fabrications after assembly.

2.10 STEEL FINISHES

A. Shop prime iron and steel items not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

1. Shop prime with manufacturer's standard, fast-curing, lead-free, modified alkyd primer FS TT-P-645.

B. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, or SSPC-SP 3, requirements indicated below:

1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
2. Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
3. Items Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
4. Other Items: SSPC-SP 3, "Power Tool Cleaning."

C. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance 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.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING METAL BOLLARDS

A. Anchor bollards in concrete footings. Fill annular space around bollard solidly with concrete. Use nonshrink, nonmetallic grout at locations at existing concrete construction. Support and brace bollards in position until concrete has cured.

B. Fill bollards solidly with concrete, mounding top surface to shed water.

3.3 INSTALLATION OF STEEL PIPE RAILINGS AND HANDRAILS

A. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Space posts at spacing indicated, or if not indicated, as required by design loadings. Plumb posts in each direction. Secure posts and railing ends to building construction as follows:

B. Anchor posts in concrete by core drilling holes not less than 5 inches deep and 1/2 inch greater than outside diameter of post. Clean holes of all loose material insert posts and fill annular space between post and concrete with the nonshrink metallic grout, mixed and placed to comply with anchoring material manufacturer's directions.

C. Anchor posts to wood construction by means of surface mounted steel plate with bolts as required by materials and conditions to meet loading requirements.

D. Anchor posts to steel with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.

E. Anchor rail ends into concrete and masonry with steel round flanges welded to rail ends and anchored into wall construction with lead expansion shields and bolts.

F. Secure handrails to wall with wall brackets and end fittings. Provide bracket with not less than 1-1/2 inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads. Secure wall brackets and wall return fittings to building construction as follows:

G. Expansion Joints: Provide expansion joints at intervals not to exceed 40 feet. Provide slip joint with internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side; locate joint within 6 inches of post.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 50 00

SECTION 06 10 00 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Framing with dimension lumber.
   2. Framing with engineered wood products.
   3. Exposed interior plywood panels.

B. Related Sections include the following:
   1. Division 06 Section "Sheathing."
   2. Division 06 Section "Metal-Plate-Connected Wood Trusses."

1.3 REFERENCES

A. American Forest and Paper Association (AF&PA): Details for Conventional Wood Frame Construction.
B. American Lumber Standard Committee (ALSC): American Softwood Lumber Standard PS 20.
C. American Plywood Association (APA):
   1. Product Standard PS1, Construction and Industrial Plywood.
   2. Product Standard PS2, Performance Standard for Wood-Based Structural-Use Panels.
   3. Product Standard PRI-400, Performance Standard for EWS I-Joists.

D. American Society of Mechanical Engineers (ASME):
   1. ASME B18.2.1 – Square and Hex Bolts and Screws (Inch Series).
   2. ASME B18.6.1 – Wood Screws (Inch Series).

E. American Society for Testing and Materials (ASTM).
F. American Wood Protection Association (AWPA):
   1. AWPA U1-07 - Use Category System: User Specification for Treated Wood
   2. AWPA T1-15 - Use Category System: Processing and Treatment Standard

G. Environmental Protection Agency (EPA)
H. Forest Stewardship Council (FSC): FSC STD-01-001 - FSC Principles and Criteria for Forest Stewardship.
I. International Building Code (IBC).
J. International Code Council - Evaluation Service (ICC-ES): Evaluation Reports.
K. National Evaluation Service (NES): NES NER 272 – Power-Driven Staples and Nails for Use in All Types of Building Construction.
L. National Wood Window and Door Association (NWWDA).

1.4 DEFINITIONS

A. Exposed Framing: Framing not concealed by other construction.
B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

C. Timber: Lumber of 5 inches nominal or greater in least dimension.

D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
2. NLGA: National Lumber Grades Authority.
3. RIS: Redwood Inspection Service.
4. SPIB: The Southern Pine Inspection Bureau.
5. WCLIB: West Coast Lumber Inspection Bureau.
6. WWPA: Western Wood Products Association.

1.5 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments specified to be High-Temperature (HT) type, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.
5. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

B. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

C. Research/Evaluation Reports: For the following, showing compliance with building code in effect for Project:
1. Wood-preservative-treated wood.
2. Engineered wood products.
3. Power-driven fasteners.
4. Powder-actuated fasteners.
5. Expansion anchors.
6. Metal framing anchors.

1.6 QUALITY ASSURANCE

A. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.

B. Forest Certification: For the following wood products, provide materials produced from wood obtained from forests certified by an FSC-accredited certification body to comply with FSC STD-01-001, "FSC Principles and Criteria for Forest Stewardship":
1. Dimension lumber framing.
2. Timber.
3. Laminated-veneer lumber.
4. Parallel-strand lumber.
5. Rim boards.
6. Miscellaneous lumber.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. 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.
   3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   4. Provide dressed lumber, S4S, unless otherwise indicated.

B. Engineered Wood Products: Provide engineered wood products acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
   1. Allowable Design Stresses: Provide engineered wood products with allowable design stresses, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1, except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated with inorganic boron (SBX).
   1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
   2. For exposed items indicated to receive a stained or natural finish, use chemical formulations that do not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
   2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
   3. Wood framing and furring attached directly to the interior of below-grade exterior masonry 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.

2.3 DIMENSION LUMBER FRAMING

A. Maximum Moisture Content: 19 percent.

B. Non-Load-Bearing Interior Partitions: Construction, Stud, or No. 3 grade and any of the following species:
   1. Northern species; NLGA.

C. Exterior and Load-Bearing Walls: No. 2 grade and any of the following species:
   1. Hem-fir (north); NLGA.
   2. Spruce-pine-fir; NLGA.

D. Ceiling Joists (Non-Load-Bearing): Construction, Stud, or No. 3 grade and any of the following species:
   1. Northern species; NLGA.

E. Joists, Rafters, and Other Framing Not Listed Above: No. 2 grade and any of the following species:
   1. Hem-fir (north); NLGA.
   2. Spruce-pine-fir; NLGA.

2.4 ENGINEERED WOOD PRODUCTS

A. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.
   1. Extreme Fiber Stress in Bending, Edgewise 2900 psi for 12-inch nominal depth members.
   2. Modulus of Elasticity, Edgewise: 2,000,000 psi.

B. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D 5456 and manufactured with an exterior-type adhesive complying with ASTM D 2559 and containing no urea formaldehyde.
   1. Extreme Fiber Stress in Bending, Edgewise: 2900 psi for 12-inch nominal depth members.
   2. Modulus of Elasticity, Edgewise: 2,200,000 psi.

C. Rim Boards: Product designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with research/evaluation report for I-joists.
   1. Manufacturer: Provide products by same manufacturer as I-joists.
   2. Material: Product made from any combination solid lumber, wood strands, and veneers. Provide rim boards made without urea formaldehyde.
   3. Thickness: 1-1/8 inches.
   4. Provide performance-rated product complying with APA PRR-401, rim board plus grade, factory marked with APA trademark indicating thickness, grade, and compliance with APA standard.

2.5 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
   1. Blocking.
   2. Nailers.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:
   1. Northern species; NLGA.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

2.6 PLYWOOD PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

B. Exposed Plywood: Sanded B/C sheets of SPF.
   1. Install exposed interior panels using black trim screws, neatly spaced.

C.

2.7 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.8 METAL FRAMING ANCHORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Simpson Strong-Tie Co., Inc.
   2. USP Structural Connectors.

B. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer, that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

C. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
   1. Use for interior locations where stainless steel is not indicated.

D. Joist Hangers: U-shaped joist hangers with 2-inch long seat and 1-1/4-inch wide nailing flanges at least 85 percent of joist depth.
   1. Thickness: 0.050 inch.

E. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
   1. Strap Width: 1-1/2 inches.
   2. Thickness: 0.050 inch.

F. Bridging: Rigid, V-section, nailless type, 0.050 inch thick, length to suit joist size and spacing.
G. Post Bases: Adjustable-socket type for bolting in place with standoff plate to raise post 1 inch above base and with 2-inch minimum side cover, socket 0.062 inch thick, and standoff and adjustment plates 0.108 inch thick.
H. Truss Tie-Downs: As indicated
I. Floor-to-Floor Ties: As indicated
J. Hold-Downs: Brackets for bolting to wall studs and securing to foundation walls with anchor bolts.
   1. As indicated

2.9 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chloropyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.
B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

D. Metal Framing Anchors: Install metal framing to comply with manufacturer's written instructions.
E. Do not splice structural members between supports, unless otherwise indicated.
F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
   1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
   2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.

3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o.c.

H. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

I. Comply with AWPA T1 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
2. Use copper naphthenate for items not continuously protected from liquid water.

J. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with Table 2304.9.1, "Fastening Schedule," in IBC.

K. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.2 WOOD SLEEPER, BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for screeding or attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.3 WOOD FURRING INSTALLATION

A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

B. Furring to Receive Plywood or Hardboard Paneling: Install 1-by-3-inch nominal size furring horizontally at 24 inches o.c.

3.4 WALL AND PARTITION FRAMING INSTALLATION

A. General: Provide single bottom plate and double top plates using members of 2-inch nominal thickness whose widths equal that of studs, except single top plate may be used for non-load-bearing partitions. Fasten plates to supporting construction, unless otherwise indicated.
1. For exterior walls, provide 2-by-8-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.
2. For interior partitions and walls, provide 2-by-4-inch nominal size wood studs spaced 16 inches o.c., unless otherwise indicated.

B. Construct corners and intersections with three or more studs, except that two studs may be used for interior non-load-bearing partitions.

C. Frame openings with multiple studs and headers. Provide nailed header members of thickness equal to width of studs. Support headers on jamb studs.
1. For non-load-bearing partitions, provide double-jamb studs and headers not less than 4-inch nominal depth for openings 48 inches and less in width, 6-inch nominal depth for openings 48 to

72 inches in width, 8-inch nominal depth for openings 72 to 120 inches in width, and not less than 10-inch nominal depth for openings 10 to 12 feet in width.

2. For load-bearing walls, provide double-jamb studs for openings 60 inches and less in width, and triple-jamb studs for wider openings. Provide headers of depth indicated.

3.5 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 10 00

SECTION 06 16 13 – STRUCTURAL INSULATING SHEATHING

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes a composite foam and weather barrier system to be provided at all exterior wall locations.

B. There are two types of systems to be used on the project t:

1. Vapor-permeable (above grade)
2. Below grade board with cementitious coating

1.3 RELATED WORK

A. Related Sections:

1. All Division 6 sections
2. All Division 7 sections

1.4 SUBMITTALS

A. Manufacturer’s data for all system components.

B. Details and drawings for standard terminations and condition applicable to this project.

C. Provide manufacturer’s 10-year warranty.

1.5 REFERANCE STANDARDS

A. ASTM E84, “Standard Test Method for Surface Burning Characteristics of Building Materials”.

B. ASTM D137-12, “Standard Test Method for Evaluating Properties of Wood based Fiber and Particle Panel Materials”, Section 15: Nail Head Pull Through.

C. ASTM E2357, “Air Leakage of Building Assemblies”.

D. ASHRAE 90.1-2013, “Energy Standard for Buildings Except Low-Rise Residential Buildings”.

E. ASTM E283-04 (2012), “Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen”.

F. ASTM E331-00 (2016), “Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference”.

G. Testing Application Standard (TAS) 202-94, “Impact & Nonimpact Resistance Building Envelope Components using Uniform Static Air Pressure”.

H. Testing Application Standard (TAS) 203-94, “Criteria for Testing Products Subject to Cyclic Wind Pressure Loading”.

I. ASTM E72-05, “Standard Test Method of Conducting Strength Tests of Panels for Building Construction”.

J. ASTM C518-17, “Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter”.

K. ASTM D1929-12, “Standard Test Method for Determining Ignition Temperature of Plastics.

L. ASTM E96-13, “Test Method for Water Vapor Transmission of Materials”.

M. ASTM C1304-08 (2013), “Standard Test Method for Assessing the Odor Emission of Thermal Insulation Materials”.

N. ASTM C1338-14, “Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings”.

O. ASTM D1761, “Standard Test Methods for Mechanical Fasteners in Wood” modified for Shear.

P. NFPA 285 (2012), “Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components”.

1.6 WARRANTY

A. Provide manufacturer’s standard 10 year warranty.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Provide system components from the following:

1. MaxLife Industries
2. Approved equal.

B. Basis of design: The specification and drawings are based on Armorwall VP and Armorwall BG composite system consisting of facer boards, rigid insulation, sheathing, air/weather barrier and related system components for a continuous and watertight installation.

2.2 MATERIALS

A. System components include:

1. Magnesium Oxide Board (MgO) Facer: 1/2” thickness

2. Polyurethane Rigid Foam Insulation:

    a. Class 1 Rated Polyurethane R-Value 6.5/inch, as shown on drawings/ 3 ¾" thickness, R-21.

3. Air and Weather Resistant Barrier: **Factory applied** Non-Permeable Coating. Permeance when tested to ASTM E96 Method A: 0.18 Perms at 10 mils

4. Sheathing Panel System Maximum Deflection on 18ga Steel Stud. L/360: +113/-75 psf (+5400/-2600 Pa). L/240: +113/-95 psf (+5400/-4560 Pa).

    a. NFPA 285 approved test assembly demonstrating passing of sheathing directly to exterior of stud facing allowing any exterior non-combustible veneer application.

5. Proprietary waterproofing (for application to below-grade panels).

B. Panel size: At contractor's option 4' x 8' or 4' x 10' sheets.

C. Flashing: Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24 gage (0.0239) inch (0.61 mm) thick base metal, shop pre-coated with PVDF coating.

D. Fasteners: As specifically recommended by the manufacturer for attachment to Wood Studs:

1. Type: #14-13, self-drilling, pancake head fastener.
2. Min embedment: One (1) inch penetration into wood stud.
3. Do not overtighten fasteners to create dimples or insets: follow the manufacturer's instructions.

E. Liquid coating, sealant, tape and related products at joints, seams and panel terminations: Provide products specifically made and approved by the manufacturer. System shall include reinforcement mesh associated with the water-proof coating for system chosen.

F. Sealant is required on the seams and through fastener penetrations on the factory coated boards to create the full air and water barrier application as required by IBC.

PART 3: EXECUTION

3.1 PREPARATION

A. Before installing panels, review substrate conditions and make sure that work done by other trades is proper, plumb and ready for the work of this section. Do not start the work until the conditions are acceptable.

B. Arrange for delivery of all materials. Store items in conditions and temperatures as required by the manufacturer.

3.2 INSTALLATION, GENERAL

A. Refer to the complete listing of manufacturer's instructions on the installation of the composite panels. Install panels using fasteners at locations and spacing as noted in the installation instruction. Confer with the manufacturer on any uncertainty or questions concerning the installation.

B. After installation of panels, apply coatings and sealants as required by the manufacturer for a complete and weather-tight installation. Apply coating over all fasteners.

C. Sequence the work as required by the manufacturer.

D. Upon completion, advise general contractor and other trades on the proper installation of surface materials and penetrations for work such as conduits, piping and related penetrations.

E. Tolerances and gaps: Gaps greater than ¼" thick will not be allowed on the project. Replace and install new sheets at locations which exceed this tolerance.

F. Holes and penetrations are limited to ¼" greater than the material used penetrating the wall.

G. After all initial work is completed and penetrations finished, parge the upper 16" with Portland based stucco mix on fiberglass mesh. See drawings for extents.

3.3 FINAL INSPECTION

A. Upon completion of the work, advise the Architect of the same and arrange for an inspection of the system prior to the installation of other work.

END OF SECTION 06 16 13

SECTION 06 17 53- METAL-PLATE-CONNECTED WOOD TRUSSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Wood roof trusses.
2. Wood girder trusses.
3. Wood truss bracing.
4. Metal truss accessories.

B. Related Sections include the following:
1. Division 06 Section "Sheathing" for roof sheathing.

1.3 REFERENCES

A. American Forest and Paper Association (AF&PA): Details for Conventional Wood Frame Construction.

B. American Lumber Standard Committee (ALSC): American Softwood Lumber Standard PS 20.

C. American Society of Mechanical Engineers (ASME):
1. ASME B18.2.1 – Square and Hex Bolts and Screws (Inch Series).
2. ASME B18.6.1 – Wood Screws (Inch Series).

D. American Society for Testing and Materials (ASTM).

E. Environmental Protection Agency (EPA)

F. National Evaluation Service (NES): NES NER 272 – Power-Driven Staples and Nails for Use in All Types of Building Construction.

G. The Society for Protective Coatings (SSPC): SSPC Paint 20 - Zinc-Rich Coating.

H. Truss Plate Institute (TPI):
1. TPI 1 - National Design Standard for Metal Plate Connected Wood Truss Construction.
2. TPI DSB - Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses.
3. TPI HIB - Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses.

I. U. S. Green Building Council (USGBC): Green Building Design and Construction Reference Guide.

1.4 DEFINITIONS

A. Metal-Plate-Connected Wood Trusses: Planar structural units consisting of metal-plate-connected members fabricated from dimension lumber and cut and assembled before delivery to Project site.

B. TPI: Truss Plate Institute, Inc.

1.5 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal-plate-connected wood trusses capable of withstanding design loads within limits and under conditions indicated. Comply with requirements in TPI 1 unless more stringent requirements are specified below.
   1. Design Loads: As indicated.
   2. Maximum Deflection Under Design Loads:
      a. Roof Trusses: Vertical deflection from dead load of 1/240 of span.
      b. Floor Trusses: Vertical deflection from live load of 1/480 of span.

1.6 SUBMITTALS

A. Shop Drawings: Prepared by or under the supervision of a specialty structural engineer. Show fabrication and installation details for trusses.
   1. Show location, pitch, span, camber, configuration, and spacing for each type of truss required.
   2. Indicate sizes, stress grades, and species of lumber.
   3. Indicate locations of permanent bracing required to prevent buckling of individual truss members due to design loads.
   4. Indicate type, size, material, finish, design values, orientation, and location of metal connector plates.
   5. Show splice details and bearing details.
   6. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the specialty structural engineer responsible for their preparation.
   7. Calculations: Contractor shall engage a specialty structural engineer to perform final design calculations and submit same, for all trusses and bracing.

1.7 QUALITY ASSURANCE

A. Metal Connector-Plate Manufacturer Qualifications: A manufacturer that is a member of TPI and that complies with quality-control procedures in TPI 1 for manufacture of connector plates.
   1. Manufacturer's responsibilities include providing professional engineering services needed to assume engineering responsibility.
   2. Engineering Responsibility: Preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.

B. Fabricator Qualifications: Shop that participates in a recognized quality-assurance program that complies with quality-control procedures in TPI 1 and that involves third-party inspection by an independent testing and inspecting agency acceptable to Architect and authorities having jurisdiction.

C. Specialty Structural Engineer Qualifications: Employ professional Engineer, registered in the state of Minnesota, to perform design of trusses and bracing to meet structural performance requirements. Sign and seal design Shop Drawings submitted to Owner for review.

D. Source Limitations for Connector Plates: Obtain metal connector plates from a single manufacturer.

E. Comply with applicable requirements and recommendations of the following publications:
   1. TPI 1, "National Design Standard for Metal Plate Connected Wood Truss Construction."
   2. TPI DSB, "Recommended Design Specification for Temporary Bracing of Metal Plate Connected Wood Trusses."
   3. TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."

F. Wood Structural Design Standard: Comply with applicable requirements in AF&PA's "National Design Specifications for Wood Construction" and it's "Supplement."

1.8 DELIVERY, STORAGE, AND HANDLING

A. Handle and store trusses to comply with recommendations of TPI HIB, "Commentary and Recommendations for Handling, Installing & Bracing Metal Plate Connected Wood Trusses."
   1. Store trusses flat, off of ground, and adequately supported to prevent lateral bending.
   2. Protect trusses from weather by covering with waterproof sheeting, securely anchored.
   3. Provide for air circulation around stacks and under coverings.

B. Inspect trusses showing discoloration, corrosion, or other evidence of deterioration. Discard and replace trusses that are damaged or defective.

1.9 COORDINATION

A. Time delivery and erection of trusses to avoid extended on-site storage and to avoid delaying progress of other trades whose work must follow erection of trusses.

1.10 FIELD MEASUREMENTS

A. Verify actual locations of existing structure, new work previously placed and other construction to which the new work must fit by accurate field measurements before submittal of related shop drawings or fabrication. Show recorded measurements on shop drawings submitted for review. Coordinate fabrication schedule with construction progress to avoid delay of Work. Provide templates and dimensions to fabricator for accurate alignment with existing conditions. Show field conditions impacting the work on the shop drawings, prior to submittal.

PART 2 - PRODUCTS

2.1 DIMENSION LUMBER

A. 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, omit grade stamp and provide certificates of grade compliance issued by grading agency.
   3. Provide dressed lumber, S4S.
   4. Provide dry lumber with 19 percent maximum moisture content at time of dressing.

B. Grade and Species: For truss chord and web members, provide dimension lumber of any species, graded visually or mechanically, and capable of supporting required loads without exceeding allowable design values according to AF&PA's "National Design Specifications for Wood Construction" and its "Supplement."

C. Minimum Chord Size For Roof Trusses: 2 by 6 inches nominal for both top and bottom chords.

D. Permanent Bracing: Provide wood bracing that complies with requirements for miscellaneous lumber in Division 6 Section "Rough Carpentry."

2.2 METAL CONNECTOR PLATES

A. General: Fabricate connector plates to comply with TPI 1.

B. Hot-Dip Galvanized Steel Sheet: ASTM A 653; Structural Steel (SS), high-strength low-alloy steel (HSLAS) Grade 40, or high-strength low-alloy steel (HSLAS) Grade 60; G60 coating designation; and not less than 0.036 inch thick.
   1. Use for interior locations where stainless steel is not indicated.

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
   1. Where trusses are exposed to weather, in ground contact, made from pressure-preservative treated wood, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Lag Bolts: ASME B18.2.1.

F. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.4 METAL TRUSS ACCESSORIES

A. Allowable Design Loads: Provide products with allowable design loads, as published by manufacturer that meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

B. Galvanized Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A 653, G60 coating designation.
   1. Use for interior locations where stainless steel is not indicated.

C. Truss Tie-Downs: Bent strap tie for fastening roof trusses to wall studs below, 1-1/2 inches wide by 0.050 inch thick. Tie fastens to one side of truss, top plates, and side of stud below.

2.5 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20, with dry film containing a minimum of 94 percent zinc dust by weight.

2.6 FABRICATION

A. Cut truss members to accurate lengths, angles, and sizes to produce close-fitting joints.

B. Fabricate metal connector plates to sizes, configurations, thicknesses, and anchorage details required to withstand design loads for types of joint designs indicated.

C. Assemble truss members in design configuration indicated; use jigs or other means to ensure uniformity and accuracy of assembly with joints closely fitted to comply with tolerances in TPI 1. Position members to produce design camber indicated.
   1. Fabricate wood trusses within manufacturing tolerances in TPI 1.

D. Connect truss members by metal connector plates located and securely embedded simultaneously in both sides of wood members by air or hydraulic press.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install wood trusses only after supporting construction is in place and is braced and secured.

B. If trusses are delivered to Project site in more than one piece, assemble trusses before installing.

C. Hoist trusses in place by lifting equipment suited to sizes and types of trusses required, exercising care not to damage truss members or joints by out-of-plane bending or other causes.

D. Install and brace trusses according to TPI recommendations and as indicated.

E. Install trusses plumb, square, and true to line and securely fasten to supporting construction.

F. Space trusses 24 inches o.c. unless noted otherwise or required to meet structural performance; adjust and align trusses in location before permanently fastening.

G. Anchor trusses securely at bearing points; use metal truss tie-downs or floor truss hangers as applicable. Install fasteners through each fastener hole in truss accessories according to manufacturer's fastening schedules and written instructions.

H. Securely connect each truss ply required for forming built-up girder trusses.
   1. Anchor trusses to girder trusses as indicated.

I. Install and fasten permanent bracing during truss erection and before construction loads are applied. Anchor ends of permanent bracing where terminating at walls or beams.
   1. Install bracing to comply with Division 06 Section "Rough Carpentry."
   2. Install and fasten strongback bracing vertically against vertical web of parallel-chord floor trusses at centers indicated.

J. Install wood trusses within installation tolerances in TPI 1.

K. Do not cut or remove truss members.

L. Replace wood trusses that are damaged or do not meet requirements.
   1. Do not alter trusses in field.

3.2 REPAIRS AND PROTECTION

A. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Repair damaged galvanized coatings on exposed surfaces with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 06 17 53

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SECTION 06 20 23 – FINISH CARPENTRY (Installation)

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. This section provides installation requirements for building items which are not included in other Division 6 sections.

1.3 RELATED WORK

A. Various other sections normally installed by carpenters or the carpentry trade including but not limited to toilet partitions, toilet accessories, counters, doors, frames, hardware, special doors and related items included within the specification manual.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Not applicable

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing any systems or items, make sure that the conditions are suitable for installation. Surfaces and materials shall be in as-new conditions. Walls shall be plumb, level and true. Irregularities and mars in exposed finishes will not be acceptable.

B. Notify the Architect in advance of any installation should imperfect conditions be found.

3.2 INSTALLATION, GENERAL

A. Install systems and products to be level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment. Provide shims or backer materials to insure a proper and precise installation.

B. It is expected that the installation work meets or exceeds standards established by the carpentry trade and that apprentice or less experienced carpenters will be supervised by a seasoned carpenter.

C. Follow the manufacturer's instructions for handling and installation of products that include installation procedures or requirements.

END OF SECTION 06 20 23

SECTION 07 21 00 - THERMAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

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1. Spray polyurethane foam insulation.
2. Rigid Insulation.
3. Mineral fiber sound attenuation blanket (batt) insulation.
4. Air and vapor retarders (barriers).

B. Rigid insulation (foam-plastic board insulation) at below grade conditions to be Extruded Polystyrene Board Insulation as specified herein. This includes foundation wall locations and at the in-floor heat locations below the floor slab.

C. Sound attenuation mineral fiber blankets are to be provided at all the interior wood framed walls.

D. Roof insulation is part of section 07 53 23 EPDM Roofing System if this alternate is selected. Roof insulation for the Structural Standing Seam Roof base bid is a part of this section.

E. Spray foam insulation shall be used in conjunction with exterior wall components to fully seal small gaps and joints for a thermal air-tight condition. This includes joints at windows, door frames and penetrations.

F. The entire exterior is insulated with composite panels as specified in Section 06 16 13.

1.3 RELATED WORK

Section 03 30 00, Cast-in-place Concrete
Section 04 22 00, Unit Masonry
Section 06 16 13, Structural Insulating Sheathing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.
B. Research/evaluation reports.

1.6 QUALITY ASSURANCE

A. Fire Performance Characteristics: Provide insulation materials with UL label or other testing and inspecting agency acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 RIGID BOARD INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products as manufactured by one of the following.

1. Amoco Foam Products Co.
2. Dow Chemical U.S.A.
3. Minnesota Diversified Products, Inc.
4. U.C. Industries
5. Owens Corning.

B. Extruded Polystyrene Board Insulation: Type IV, 1.6 lb., rigid, cellular thermal insulation with closed-cells and integral high density skin, formed by the expansion of polystyrene base resin in an extrusion process to comply with ASTM C 578 for type indicated; with 5-year aged R-values of 5.4 and 5 at 40 and 75 deg. F (4.4 and 23.9 deg. C), respectively.

2.2 SOUND BATT MINERAL-FIBER BLANKETS

A. Manufacturers: Subject to compliance with requirements, provide products as manufactured by one of the following.

1. CertainTeed Corporation.
2. Johns Manville.
3. Knauf Insulation.
4. Owens Corning.
5. Dow Chemical

2.3 SPRAY POLYURETHANE FOAM INSULATION

A. Closed-Cell Polyurethane Foam Insulation: ASTM C 1029, Type II, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, per ASTM E 84. Locations as indicated in drawings.

1. Manufacturers: Subject to compliance with requirements, [provide products as manufactured by one of the following]

a. BASF Corporation.

b. Dow Chemical Company (The).
c. Gaco Western Inc.
d. Henry Company.

2. Minimum density of 1.5 lb/cu. ft.thermal resistivity of 6.2 deg F x h x sq. ft./Btu x in. at 75 deg F.

2.4 ACCESSORIES

A. Vapor Retarders:
1. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.
2. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Bonding Insulation: Type recommended by insulation manufacturer, complying with requirements for fire performance characteristics.

C. Mechanical Anchors: Type and size indicated or, if not indicated, as recommended by insulation manufacturer for type of application and condition of substrate.

D. Mastic Sealer: Type recommended by insulation manufacturer for bonding edge joints between units and filling voids in work.

E. Crack Sealer for Board Insulation: Provide polymeric insulating foam in aerosol dispenser designed for filling voids in board insulation.
1. Product: Subject to compliance with requirements, provide "Polycel 100" by Const. Products Div., W.R. Grace & Co.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications indicated.

B. General Protection: Protect insulations from physical damage and from becoming wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation. Store materials so that they are not exposed to sunlight except during the immediate installation period.

C. Require Installer to examine substrates and conditions under which insulation work is to be performed. A satisfactory substrate is one that complies with requirements of the section in which substrate and related work is specified. Obtain Installer's written report listing conditions detrimental to performance of work in this section. Do not proceed with installation of insulation until unsatisfactory conditions have been corrected.

D. Clean substrates of substances harmful to insulations or vapor retarders, including removal of projections which might puncture vapor retarders.

E. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

F. Extend insulation to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

G. Provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

H. In all cases, follow the manufacturer's recommendations on the installation of each type of building insulation.

3.2 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Foam-Plastic Board Insulation: Seal joints between units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Glass-Fiber: Install in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
4. For metal-framed wall cavities where cavity heights exceed of 96 inches support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
5. For wood-framed construction, install blankets according to ASTM C 1320.

D. Loose-Fill Insulation: Install according to ASTM C 1015 and manufacturer's written instructions. Level horizontal applications to uniform thickness required for R038 thermal barrier, lightly settle to uniform density, but do not compact excessively.

E. Spray-Applied Insulation: Apply spray-applied insulation according to manufacturer's written instructions. Do not apply insulation until installation of pipes, ducts, conduits, wiring, and electrical outlets in walls is completed and windows, electrical boxes, and other items not indicated to receive insulation are masked. After insulation is applied, make flush with face of studs by using method recommended by insulation manufacturer.

F. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

1. Loose-Fill Insulation: Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.
2. Spray Polyurethane Insulation: Apply according to manufacturer's written instructions.

3.3 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs.

1. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners of 24 inches o.c.
2. Before installing vapor retarders, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.
3. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

C. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

D. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

END OF SECTION 07 21 00

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SECTION 07 41 20 – STRUCTURAL STANDING SEAM METAL ROOFING

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1. Performance of the Work of this Section shall comply with Division 00 Prevailing Wage Rate Requirements that apply to this project.

1.01 SUMMARY

A. Furnish and install structural metal panel roofing system, including:

1. Roofing panels warranted to the roof pitch as shown on the drawings.
2. Preparation of roofing substrates.
3. Flashings.
4. Roofing Underlayment
5. Other roofing-related items specified or indicated on the drawings or otherwise necessary to provide a complete roofing system.

B. Commencement of work by the Contractor shall constitute acknowledgement by the Contractor that this specification can be satisfactorily executed, under the project conditions and with all necessary prerequisites for warranty acceptance by roofing system manufacturer. No modification of the Contract Sum will be made for failure to adequately examine the Contract Documents or the project conditions.

C. Sections of roofing shall be one-piece units, continuous and complete from ridge to eave.

D. Refer to section 072100 for insulation used as a part of this system.

E. This section is bid as a base bid with EPDM roofing as an alternate.

1.02 RELATED SECTIONS

A. Section 06 10 00 - Rough Carpentry (for surface materials)
B. Section 07 62 00 - Sheet Metal Flashing and Trim: Formed metal flashing and trim items associated with non-metal roofing.
C. Section 07 53 23, EPDM Roofing System.
D. Section 07 72 53, Snow Guards.

1.03 REFERENCES

A. Referenced Standards: These standards form part of this specification only to the extent they are referenced as specification requirements.
1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2011.
3. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as

Sheathing; 2008.
4. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2013.
5. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2013.
6. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2013a.
7. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; American Society for Testing and Materials; 2011.
8. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2012.
9. ASTM E1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference; American Society for Testing and Materials; 2005 (Reapproved 2012)
10. ASTM E1646 - Standard Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference; American Society for Testing and Materials; 1995 (Reapproved 2011).
11. ASTM E1680 - Standard Test Method for Rate of Air Leakage Through Exterior Metal Roof Panel Systems; American Society for Testing and Materials; 2011.
12. MBMA - Metal Roofing Systems Design Manual; Metal Building Manufacturers Association; 2012.
13. PS 1 - Construction and Industrial Plywood; 2009.
14. PS 20 - American Softwood Lumber Standard; 2010.
15. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.
16. UL 2218 - Standard for Impact Resistance of Prepared Roof Covering Materials; Underwriters Laboratories Inc.; Current Edition, Including All Revisions.

1.04 SUBMITTALS

A. Product Data: Submit manufacturer's data sheets on each product to be installed and manufacturer's standard detail drawings applicable to this project.

B. Samples: Submit following samples for approval:
   1. Color chips for selection of finish color and sheen.

C. Shop Drawings: Provide drawings prepared especially for this project for all relevant conditions, including plans and elevations, sections and details, specified loads, flashings, roof edges, terminations, expansion joints, curbs, penetrations, and drainage. Specifically include interfaces with materials not supplied by metal roof panel manufacturer and identify each component and its finish.

D. Manufacturer's Installation Inspection Reports: Manufacturer (if applicable) may, at its option, inspect the installation at any time to appraise the installing contactor of their compliance with manufacturer's requirements. Typical inspections will include:
   1. Prior to the installation of the metal roofing panels to inspect the underlayments. The roofing contractor is responsible for assuring that the substrate is in suitable condition for the installation of the metal roofing components to the substrate.
   2. Intermediate inspections to ensure proper installation of the metal roofing panels (if required).
   3. At final completion of all metal roofing system work.

E. Sample warranty.

F. Executed Warranty, by authorized company official with final close-out.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Roofing installer shall have received training from metal panel manufacturer for installation of the specified roof panel system.

B. Contractor shall have a minimum of five years' experience in fabricating and installing structural metal standing seam roofing systems.

1.06 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact and legible.
B. Exercise extreme care in unloading, storing, and installing metal panels to prevent bending, warping, twisting, and surface damage.
C. Store products above ground on well-supported platforms that provide minimum of 1:48 slope. Store under waterproof covering or indoors and provide proper ventilation of metal components to prevent condensation build-up between metal components.

1.07 WARRANTY

A. Comply with all warranty procedures required by manufacturer, including notifications, scheduling, and inspections.
B. Manufacturer's warranty is in addition to, and not a limitation of, other rights the owner may have under the contract documents.
C. Warranty: Standard full system warranty covering roof panels and associated metal components, roof sheathing/insulation and accessories, covering weather-tightness, finish, materials, labor, and workmanship.

1. Limit of Liability: No dollar limitation.

2. Scope of Coverage: Repair leaks in the roofing system caused by:
   a. Ordinary wear and tear of the elements.
   b. Manufacturing defect in Firestone brand materials.
   c. Defective workmanship used to install these materials.
   d. Damage due to winds up to 70 mph.

D. Fluoropolymer Finish Warranty: Provide coating which has been field tested under normal range of weathering conditions without significant peel, blister, flake, chip, crack or check in finish, and without chalking in excess of 8 (ASTM D 659), and without fading in excess of 5 NBS units.

1. Warranty Period**: 20 years commencing on date of substantial completion.**

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. This is a performance based specification based on Fabral "Stand 'N Seam" series. Provided that the contractor is able to conform to all specified requirements, roofing may be factory formed and made or made on site.

B. During the bidding, contractors shall submit qualifications to the Architect for approval.

2.02 ROOFING SYSTEM DESCRIPTION

A. Roofing System: Standing seam metal roof panels and other components, together forming a watertight assembly having the following characteristics:

1. Panel Seam Type: Self-locking, double locking seam requiring field seaming.
2. Panel Material: Steel, 24 gauge (0.64 mm) with fluoropolymer finish, over G90 hot-dipped galvanized coating.
3. Integration of panels: Panels shall be mechanically seamed.
4. Color: To be selected from manufacturer's standard colors.
5. Design Loads: In accordance with ASCE 7, current edition.
   a. Design Snow Load: Not less than 20 psf (960 kPa).
   b. Maximum Deflection Under Snow Load: Not more than L/180 or as recommended by ASCE 7, whichever is less.
   c. Wind Uplift Resistance: Class 90 rating, minimum, when tested in accordance with UL 580.
   d. Wind Pull-Off Resistance: No failure of roof panel or fasteners when tested in accordance with ASTM E1592 for negative loading equal to negative design wind load; for assemblies not tested, capacity for gauge, span, or loading may be determined by interpolating between test values only.
6. Impact Resistance: Minimum of Class 4, when tested in accordance with UL 2218.
7. Thermal Effects: Design roof panels and their attachment to allow free movement in response to expansion and contraction forces resulting from temperature variation, as specified in the MBMA Metal Roofing Systems Design Manual.
8. External Fire Resistance: Class A when tested in accordance with ASTM E108 or UL 790.
9. Provide all necessary members and connections, whether indicated in the manufacturer's standard detail drawings or not.
10. Accessories and Fasteners: Capable of resisting the specified design wind uplift forces and allowing for thermal movement of the roof panel system, not restricting free movement of the roof panel system resulting from thermal forces except at designed points of roof panel fixity.

2.03 ROOF PANELS AND SHEET METAL FABRICATIONS

A. Roof Panels: Provide roll formed roofing panels produced in a permanent factory environment with fixed-base roll-forming equipment, or field produced with manufacturer approved trailer mount roll seaming machines that fully complies with manufacturer systems and warranty requirements including the following:

   1. Seam Height: 2-1/2 inches (38 mm).
   2. Seam Spacing (Panel Width): 16" on center overall with 12" coverage
   3. Profile: Flat with 2 striations.
   4. Texture: Smooth.
   5. Provide factory applied integral seam sealant in leg of panel.
   6. Form roofing panels in longest practical lengths, true to shape, accurate in size, square, and free from distribution or manufacturing defects.

B. Steel Sheet: ASTM A653/A653M, lock-forming quality, extra smooth, tension-leveled, galvanized.

C. Fluoropolymer Coating: 70 percent full strength Kynar 500/Hylar 5000.
   1. Exposed Surface: 1.0 mil (0.25 mm) plus/minus 0.1 mil (0.025 mm) total dry film thickness.
   2. Concealed Surface: 0.2 to 0.3 mils (0.05 to 0.08 mm) total dry film thickness.
   3. Color: To be selected from manufacturer's standard colors.

D. Sheet Metal Components Associated with Metal Roof Panels: Made by same manufacturer and compatible with roof panels; of not less than minimum thickness required by roof panel manufacturer.
   1. Fabricate trim, flashing, and accessories to roofing manufacturer's specified or approved profiles.
   2. Exposed metal components of same finish as panels.
   3. Color: Same as panels.

2.04 ACCESSORY MATERIALS

A. Self-Adhered Underlayment: Rubberized sheet waterproof membrane complying with ASTM D 1970/D1970M, self-adhering.
   1. Resistance to Direct Exposure: At least 90 days.
   2. Minimum High Temperature Resistance: 230 degrees F (110 degrees C).
   3. Water Vapor Permeance: 0.1 perm (5.7 ng/(Pa s sq m)), maximum.

B. Fasteners: In strict accordance with metal roof panel manufacturer's requirements; minimize exposed fasteners.
   1. Fasteners Exposed to Weather: Sealed or with sealed washers on exterior side of covering to waterproof fastener penetration; washer material compatible with screw head; minimum 3/8 inch (9.5 mm) diameter washer for structural connections; gasket portion of fasteners or washers made of EPDM, neoprene, or other equally durable elastomeric material.
   2. Fasteners Exposed to View: Head of color matching panel or component in which installed.

PART 3 INSTALLATION

3.01 GENERAL

A. Install roofing, insulation, flashings, and accessories in accordance with roofing manufacturer's published instructions and recommendations for the specified roofing system. Where manufacturer provides no instructions or recommendations, follow good roofing practices and industry standards. Comply with federal, state, and local regulations.

B. Obtain all relevant instructions and maintain copies at project site for duration of installation period.

C. Verify that shop drawings prepared by metal roof panel manufacturer have been approved and are available to installers; do not use drawings prepared by others for installation drawings.

D. Verify that the specifications and drawing details are workable and not in conflict with the roofing manufacturer's recommendations and instructions; start of work constitutes acceptable of project conditions and requirements.

E. Do not start work until Pre-Installation Notice has been submitted to manufacturer as notification that this project requires a manufacturer's warranty.

F. Perform work using competent and properly equipped personnel.

G. Temporary closures, which ensure that moisture does not damage any completed section of the new roofing system, are the responsibility of the applicator. Completion of flashings, terminations, and temporary closures shall be completed as required to provide a watertight condition.

H. Install roofing only when surfaces are clean, dry, smooth and free of snow or ice; do not apply roofing during inclement weather or when ambient conditions will not allow proper application; consult manufacturer for recommended procedures during cold weather. Do not work with sealants and adhesives when material temperature is outside the range of 60 to 80 degrees F (15 to 25 degrees C).

I. Protect adjacent construction, property, vehicles, and persons from damage related to roofing work; repair or restore damage caused by roofing work.
   1. Protect from spills and overspray from bitumen, adhesives, sealants and coatings.
   2. Particularly protect metal, glass, plastic, and painted surfaces from bitumen, adhesives, and sealants within the range of wind-borne overspray.
   3. Protect finished areas of the roofing system from roofing related work traffic and traffic by other trades.

3.02 EXAMINATION

A. Examine roof deck to determine that it is sufficiently rigid to support installers and their mechanical equipment and that deflection will not strain or rupture roof components or deform deck.

B. Verify that surfaces and site conditions are ready to receive work. Correct defects in the substrate before commencing with roofing work.

C. Verify that installed work of other trades that such work is complete to a point where the roofing system installation may commence.

D. Verify that roof openings, curbs, pipes, sleeves, ducts, vents, and other penetrations through roof substrate are complete and properly located.

E. In event of discrepancy, notify Architect in writing; do not proceed with installation until discrepancies have been resolved.

3.04 UNDERLAYMENT INSTALLATION

A. Install underlayment in accordance with manufacturer's instructions.

B. Install self-adhered underlayment over entire roofing surface.

3.05 ROOF PANEL INSTALLATION

A. Install the metal roof panel system in accordance with the manufacturer’s instructions, installation drawings, and approved shop drawings, so that it is weathertight and allows for thermal movement.

B. Locate and space all fasteners in accordance with roof panel manufacturer’s recommendations. For required exposed fasteners, use proper torque settings to obtain controlled uniform compression for a positive seal without rupturing the sealing washers.

C. Do not place utility penetrations through the panel seams.

D. Do not allow panels or trim to come into contact with dissimilar materials (i.e. copper, lead, graphite, treated lumber, mortar, etc). Protect from water run-off from these materials.

E. Perform field cutting of panels and related sheet metal components by means of hand or electric shears. At no time shall a hot/friction saw be used.

F. Remove protective film immediately after installation.

3.06 FLASHING AND ACCESSORIES INSTALLATION

A. Install flashings, including laps, splices, joints, bonding, adhesion, and attachment, as required by roof panel manufacturer's recommendations and details.

B. Install metal trim, accessories, and edgings in locations indicated on the drawings.
   1. Follow roofing manufacturer's instructions.
   2. Remove protective plastic surface film immediately before installation.

C. Flashing at Walls, Curbs, and Other Vertical and Sloped Surfaces: Install weathertight flashing at all walls, curbs, parapets, curbs, skylights, and other vertical and sloped surfaces that the roofing system abuts to; extend flashing at least 8 inches high above panel surface.

D. Flashing at Penetrations: Flash all penetrations passing through the panel; make flashing seals directly to the penetration.
   1. Pipes, Round Supports, and Similar Items: Flash with specified pre-molded pipe flashings.
   2. Where pre-molded pipe flashings are not practical, provide flashing detail as recommended by metal panel manufacturer.

3.07 FIELD QUALITY CONTROL

A. Inspection by Manufacturer: Provide final inspection of the roofing system by a Technical Representative employed by roofing system manufacturer specifically to inspect installation for warranty purposes (i.e. not a sales person).

B. Perform all corrections necessary for issuance of warranty.

3.08 ADJUSTING AND CLEANING

A. Repair panels having minor damage.

B. Remove panels damaged beyond repair and replace with new panels to match adjacent undamaged panels.

C. Clean all contaminants generated by roofing work from building and surrounding areas, including adhesives, sealants, and coatings.

D. Remove leftover materials, trash, debris, equipment from project site and surrounding areas.

END OF SECTION 07 41 20

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SECTION 07 42 15 – ARCHITECTURAL METAL PANELS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes stainless steel metal panels and mounting system, along with all related accessories for a complete installation, with base bid as follows:

1. Factory formed wall panels
2. Trim, edge profiles and termination sections
3. Flashing at base conditions.
4. Non-exposed fasteners, supports and accessories.
5. Caulking

B. There is an alternate bid as a part of this section. In lieu of the base bid formed metal panels (nominal 15” x 10”) provide horizontal symmetrical rib type.

C. Refer to Section 079200 for Joint Sealants.

1.3 RELATED WORK

A. Related Sections:

1. 06 16 13 Structural Insulating Sheathing (includes base for fastening)
2. 07 92 00 Joint Sealers

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meeting: Conduct a pre-installation meeting at the job site attended by Owner, Architect, Manufacturer’s Technical Representative, Panel Installer and Contractors of related trades. Coordinate all installation requirements specific to the work of the entire wall assembly.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer current technical literature for each type of product.

B. Shop Drawings: Submit detailed drawings showing:

1. Details
2. Location, layout and dimensions of panels
3. Location and type of fasteners
4. Shape and method of attachment

5. Other details as may be required for a weather-tight installation

C. Samples: Provide actual metal color samples for selection by the Architect, total of 2.

1.6 QUALITY ASSURANCE

A. Qualifications:

1. Manufacturer shall have a minimum of three (3) years' experience in the production of the panels.
2. Installer shall have a minimum of three (3) years' experience in the installation of products or panels similar to those specified herein.

B. Installer shall be approved, certified or authorized by the manufacturer to install panel system.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver panel materials and components in manufacturer's original, unopened, undamaged packaging with identification labels intact.

B. Store wall panel materials on dry, level, firm, and clean surface. Stack no more than two bundles high. Elevate one end of bundle to allow moisture run-off, cover and ventilate to allow air to circulate and moisture to escape.

1.8 WARRANTY

A. Provide manufacturer's standard warranty certifying the products shall be free from material defects for a period of three years.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to requirements, provide from one of the following:

1. Millennium Forms, LLC (Elkhorn, WI)
2. Approved equal during bidding only.

2.2 MATERIALS

A. Base bid, general: ZalMagWall Tiles. Individualized wall tiles with four sided interlocking design, self-aligning tab, and concealed nailing strip with two holes.

B. Panel System Description:
1. Material: ZalMag
   a. Large Tile, Flat
   b. Pre-Patina II
2. Size: 15" x 9-5/8", exposure 14-1/2" x 8-5/16" (+/- 1/16")
3. Thickness: 28 gage.
4. Strength: ASTM E8/E8M
5. Recycled Content: 75 percent

6. Performance rating wind: 110 mph.
7. Style: Flat Tile

C. Panel System Components: Provide manufacturer's standard and custom components in the same material and color as specified, as required by the manufacturer for a complete installation, including but not limited to the following:

1. Corners
2. Furring
3. Flashing.
4. Reveals
5. Fasteners: Stainless steel ring-shank roofing nails or stainless steel screws
   a. Minimum length: 3d
6. Slip sheets.
7. Reglets
8. Other accessories as required for a complete installation.

D. Panel Finish: Zalmag Pre-Patina II.

E. Alternate bid panels:

1. Provide 24 gage 1" thick continuous interlocking metal panels in symmetrical rib design in Kynar finish including all corners, terminations, fasteners and accessories for a complete installation.
2. Panels shall include 3 ribs and have an overall width of 16" but this is a nominal dimension requirement and the contractor / manufacturer is allowed flexibility in actual size.
3. Provide panels or products as manufactured by Metal Sales, Firestone and other approved supplier. System is based on Apex Series (Metal Sales).
4. Contractor is responsible for designing and proposing to Architect options for all details required for making this substation. Architect may require contractor to resubmit details to comply with whole of building.

F. Assembly:

1. Factory made in conformance with SMACNA recommendations and standards.

2. Units shall be formed and shaped to precise standards, plumb, level and designed to prevent leakage or damage to the building exterior.

3. Prevent oil canning and marred surfaces during the process.

4. Fabricate panels so that all exposed surfaces and accessories are pre-finished in the color selected.

5. Perform work in the shop under precise conditions and continuous tests to assure durability and performance.

G. Joints: Where required, provide sealant joints as necessary to secure and make weather-tight all conditions.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Provide field measurements to manufacturer as required to achieve proper fit of the preformed wall panel envelope. Measurements shall be provided in a timely manner so that there is no impact to construction or manufacturing schedule.

B. Supporting framing: Furnished under another section, installation of thermal clips and associated framing shall be coordinated by the contractor of this section to assure proper layout and installation of the high density timber faced panels, which shall be at a minimum:

1. Plus or minus 1/8 inch in 5 feet in any direction along plane of framing.
2. Plus or minus 1/4 inch cumulative in 20 feet in any direction along plane of framing.
3. Plus or minus 1/2 inch from framing plane on any elevation.
4. Plumb or level within 1/8 inch at all changes of transverse for performed corner panel applications.
5. Verify that bearing support has been provided behind vertical joints of horizontal panel systems and horizontal joints of vertical panel systems. Width of support shall be as recommended by manufacturer.

C. Examine individual panels upon removing from the bundle; notify manufacturer of panel defects. Do not install defective panels.

3.2 PANEL INSTALLATION

A. Installation shall be in accordance with manufacturer's installation guidelines and recommendations.

B. Panels are to be factory produced. Field fabrication is not allowed.

C. Install panels plumb, level, and true-to-line to dimensions and layout indicated on approved shop drawings.

D. Sequentially install wall panel system using spacing, tolerances and reveals as recommended by manufacturer or otherwise indicated on the approved shop drawings.

E. In general field fabrication is not allowed. If required and allowed by the manufacturer, cut panels with commercial equipment at slow speeds and carbide blades.

3.3 TRIM INSTALLATION

A. Place trim and trim fasteners only as indicated per details on the approved shop drawings.

B. Field drill weep holes where appropriate in horizontal trim; minimum 1/4 inch diameter at 24 inches on center.

C. Place a continuous strip of butyl tape or butyl tube sealant on closure trims for the length of the panel to be covered by trim.

3.4 CLEANING AND PROTECTION

A. Remove factory-applied protective film immediately after installation.

B. Touch-up, repair or replace panels and trim that have been damaged and are repairable per the manufacturer's standards. Replace any panels that are not repairable with new units.

C. After wall panel installation is complete, clean all panels of dust, dirt and other unsightly marks.

END OF SECTION 07 42 15

SECTION 07 53 23 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING SYSTEM

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

1. Adhered Membrane Roofing System
2. Rigid insulation board, tapered boards and accessories
3. Install of roof curbs with assistance from Mechanical Contractor

B. All system components (membrane, insulation, vapor retarders) of this section is bid as an alternate.

1.3 RELATED WORK

A. Section 05 31 00, Steel Decking

B. Section 07 62 00, Sheet Metal Flashing and Trim

C. Section 07 41 14, Structural Standing Seam Roofing.

D. Refer to Mechanical drawings for all Mechanical drains, piping, equipment, and related work

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated including Manufacturer’s Technical Information Sheet and Application / Installation Instructions.

B. Shop Drawings: For roofing system. Submit complete shop drawings, including plans, elevations, sections, details, and attachments to other work.

C. Samples: For each membrane and walkway paver included in the Roofing System.

D. Provide diagram and calculations showing minimum average R-value of 30 for complete roof assembly.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by Membrane Roofing System manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

B. Source Limitations: Obtain components including for Membrane Roofing System approved by membrane roofing manufacturer.

C. Exterior Fire-Test Exposure: ASTM E 108, Class A, as determined by testing identical membrane roofing materials by a qualified testing agency. Materials shall be identified with appropriate markings of applicable testing agency.

D. Pre-installation Roofing Conference: General contractor shall arrange and conduct conference at Project site with all associated contractors, owner’s agent, and Architect. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference. The roof conference shall take place after or during deck installation, and must be held prior to any roof work being performed.

E. Written assurance of compatible materials: Provide assurance that new membrane roofing is compatible with existing membrane(s).

1.7 ENVIRONMENTAL REQUIREMENTS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit roofing system to be installed according to manufacturer's written instructions and warranty requirements.

B. Install roofing membrane only when surfaces are clean, dry, smooth and free of snow or ice.

C. Do not apply roofing membrane during inclement weather or when ambient conditions will not allow proper application.

1.8 WARRANTY

A. Special “Full System” Warranty: Manufacturer's warranty, without monetary limitation, in which manufacturer agrees to provide labor and materials required to repair or replace components of membrane roofing system that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

1.9 DELIVERY, STORAGE AND HANDLING

A. Deliver products in manufacturer’s original containers dry, undamaged, seals and labels intact and legible.

B. Store all materials clear of ground and moisture with weather protective covering.

C. Keep all combustible materials away from ALL ignition sources.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlisle SynTec Incorporated.
2. Firestone Building Products.
3. GenFlex Roofing Systems.
4. Johns Manville.

2.2 MATERIALS

A. General compatibility: provide products which are required by manufacturers to be fully compatible with indicated substrates, or with existing substrates, or provide separation materials as required to eliminate direct contact between incompatible materials.

B. EPDM: ASTM D 4637, Type II, scrim or fabric, uniform, flexible EPDM sheet.

1. Thickness: 60 mils nominal.
2. Exposed Face Color: Black or Dark Gray.
3. Reinforced or unreinforced as recommended by the manufacturer (subject to compliance with specified warranty).

C. EPDM 60 mil unreinforced or reinforced membrane* : Ethylene propylene diene monomers formed into uniform, flexible sheets, complying with the following:
1. Tensile Strength (ASTM D 412): 1400 psi minimum.
2. Ultimate Elongation (ASTM D 412): 300% minimum.
3. Brittleness Temperature (ASTM D 746): -49 deg.F (-45 deg.C).
4. Tear Resistance (ASTM D 624): 125 lbs. per lin. inch min.
5. Resistance to Ozone Aging (ASTM D 1149): No cracks.
6. Resistance to Heat Aging (ASTM D 573): 8.3 MPa; tensile minimum to be 1200 psi.
7. Thickness: **60 mil** nominal thickness.
8. Exposed Face Color: Black or Dark Grey.
9. Type of reinforcement is dependent on manufacturer used, subject to compliance with the warranty specified.

2.3 AUXILIARY MEMBRANE ROOFING MATERIALS

A. General: Auxiliary membrane roofing materials recommended by roofing system manufacturer for intended use and compatible with membrane roofing.
Adhesives and sealants that are not on the exterior side of weather barrier shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

a. Plastic Foam Adhesives: 50 g/L.
b. Gypsum Board and Panel Adhesives: 50 g/L.
c. Multipurpose Construction Adhesives: 70 g/L.
d. Fiberglass Adhesives: 80 g/L.
e. Single-Ply Roof Membrane Adhesives: 250 g/L.
f. Single-Ply Roof Membrane Sealants: 450 g/L.
g. Nonmembrane Roof Sealants: 300 g/L.
h. Sealant Primers for Nonporous Substrates: 250 g/L.

B. Sealant Primers for Porous Substrates: 775 g/L.

C. Sheet Flashing: 60-mil thick EPDM, partially cured or cured, according to application.

D. Protection Sheet: Epichlorohydrin or neoprene non-reinforced flexible sheet, 55- to 60-mil thick, recommended by EPDM manufacturer for resistance to hydrocarbons, non-aromatic solvents, grease, and oil.

E. Bonding Adhesive: Manufacturer's standard.

F. Seaming Material: Manufacturer's seam slice tape especially designed, tested and manufactured for use between EPDM membranes, 2-1/2"to 3" wide by 1/4" thick, continuous. At special conditions provide standard splice adhesive, including edge sealer to cover exposed spliced edges as required by manufacturer of roofing system.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide molded pipe flashing, lap sealant, cant strips, tapered edge strips, water cutoff mastic, metal termination bars, metal battens, pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside

corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

2.3 SUBSTRATE BOARDS

A. Substrate Board: Provide as recommended by the manufacturer.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening substrate panel to roof deck.

2.4 ROOF INSULATION

A. Polyisocyanurate Board Insulation: : Rigid, thermal insulation of polyiso foam boards permanently bonded to facers sheets at each side complying with RIC/TIMA Bulletin #281-1, minimum K-value of 0.17. ASTM C 1289. **Provide thickness as required for a minimum aged R-value of 30.**

B. Tapered Insulation: Provide factory-tapered insulation boards fabricated to a minimum 1/4” / ft slope, or as indicated.

C. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.5 INSULATION ACCESSORIES

A. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Approvals 4470, designed for fastening roof insulation to substrate, and acceptable to roofing system manufacturer.

B. Insulation Adhesive: Insulation manufacturer's recommended cold-applied adhesive formulated to attach roof insulation to substrate or to another insulation layer.

2.7.1 VAPOR RETARDER

A. Vapor Retarders

1. Polyethylene Vapor Retarders: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.

2. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. General: Comply with manufacturer's detailed instructions, except where more stringent requirements are indicated.

B. Details as shown on drawings are typical for one manufacturer. If approved manufacturer's details differ, contractor shall install roof system in accordance with manufacturer's instructions. There shall be no added cost to the owner for compliance with manufacturer's standard details. Provide detail changes to Architect in accordance with "Submittals" process.

C. General: Extend insulation (including tapered sections) over entire surface to be tapered or insulated, cutting and fitting tightly around obstructions. There shall be a minimum of three layers of insulation, wood fiberboard or perlite at any point of new construction. Stagger all joints, including new boards over existing insulation. Form cant strips, crickets, saddles, and tapered areas with additional material as shown and as required for proper drainage of membrane.

D. Do not install more insulation each day than can be covered with membrane before end of day and before start of inclement weather.

E. Set units in adhesive, applied in accordance with requirements of applicable fire and insurance ratings.

F. Secure roof insulation to substrate as required for each system specified. Where applicable, use mechanical anchors of type and spacing indicated; but in no case provide less than one anchor per 4 square feet of surface area, or less anchorage than required by FM "Loss Prevention Data Sheet 1-28".

3.2 INSTALLATION OF VAPOR RETARDERS

A. Place vapor retarders on side of construction indicated on Drawings. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives or other anchorage system as indicated. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarders.

C. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 SUBSTRATE BOARD

A. As required by the manufacturer, install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to membrane roofing system manufacturers' written instructions.

3.4 INSULATION INSTALLATION

A. Coordinate installing membrane roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with membrane roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

3.5 FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to membrane roofing system manufacturer's written instructions.

B. Use the longest pieces of material possible.

C. Extend flashing a minimum of 8”, or as shown on drawings.

D. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.

E. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

F. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing.

G. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: Owner may engage a qualified independent testing agency to perform inspections.

B. Manufacture’s Preliminary, Interim and Final Roof Inspections: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation before, during and after installation and provide field quality reports for each inspection.

C. Repair or remove and replace components of membrane roofing system where inspections indicate that they do not comply with specified requirements.

END OF SECTION 07 53 23

SECTION 07 60 00 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes the following:

1. Sheet metal flashing, trim and counterflashing associated with the roofing.
2. Soffit Panels and Fascia
3. Sealants.

B. Refer to other Division 7 sections for related work.

C. Open-faced downspouts shall have colored metal finish at all locations exposed to view.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For sheet metal flashing, trim and roofing.

1. Include plans, elevations, sections, and attachment details.
2. Distinguish between shop- and field-assembled work.
3. Include pattern of seams and details of termination points, expansion joints and expansion-joint covers, direction of expansion, roof-penetration flashing, and connections to adjoining work.

C. Samples: For each exposed product and for each color and texture specified.

D. Sample warranty.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.

1. For copings and roof edge flashings that are SPRI ES-1 tested, shop shall be listed as able to fabricate required details as tested and approved.

1.5 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace sheet metal flashing and trim that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the following:
   a. Colorklad: Ryerson Building Products
   b. Pac-Clad: Petersen Aluminum Corp.
   c. UnaClad

2.2 MATERIALS

A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying strippable, temporary protective film before shipping.

B. Prefinished Steel: Commercial quality 24 gage hot dipped galvanized steel (G-90), smooth primed and finished one side with Kynar based flouropolymer coating of 1.0 ($\pm$0.1) mil total dry film thickness.; pre-painted by coil-coating process to comply with ASTM A 755/A 755M.

1. Exposed Coil-Coated Finish:
   a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   b. Color: As selected by Architect from manufacturer's full range. Selection shall include metallic colors.

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 46 mils thick, consisting of a slip-resistant polyethylene- or polypropylene-film top surface laminated to a layer of butyl- or SBS-modified asphalt adhesive, with release-paper backing; specifically designed to withstand high metal temperatures beneath metal roofing. Provide primer according to written recommendations of underlayment manufacturer.

1. Products: Subject to compliance with requirements, **provide one of the following**:

   a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
   b. Grace Construction Products, a unit of W. R. Grace & Co.-Conn.; Grace Ice and Water Shield HT.
   c. Henry Company; Blueskin PE200 HT.
   d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
   e. Owens Corning; WeatherLock Specialty Tile & Metal Underlayment.
   f. Polyguard Products, Inc.; Deck Guard HT.

2. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F or higher.

3. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F or lower.

B. Slip Sheet: Rosin-sized building paper, 5 lb/100 sq. ft. minimum.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, protective coatings, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and as recommended by manufacturer of primary sheet metal or manufactured item unless otherwise indicated. Use same metal as flashing / sheet metal or, other noncorrosive metal as recommended by sheet manufacturer. **Match finish** of any exposed heads with material being fastened.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal or manufactured item.

1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.

   a. Exposed Fasteners: Heads matching color of sheet metal with factory-applied coating. Provide metal-backed EPDM or PVC sealing washers under heads of exposed fasteners bearing on weather side of metal.
   b. Blind Fasteners: High-strength aluminum or stainless-steel rivets suitable for metal being fastened.
   c. Spikes and Ferrules: Same material as gutter; with spike with ferrule matching internal gutter width.

2. Fasteners for Zinc-Coated (Galvanized)Steel Sheet: Series 300 stainless steel or hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

C. Sealant Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.

D. Elastomeric Sealant: ASTM C 920, polyurethane sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight. Refer to Section 079000.

E. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

F. Epoxy Seam Sealer: Two-part, noncorrosive, seam-cementing compound, recommended by metal sheet manufacturer for exterior nonmoving joints, including riveted joints.

2.5 FABRICATION, GENERAL PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim assemblies shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.

B. Sheet Metal Standard for Flashing and Trim: Comply with NRCA's "The NRCA Roofing Manual" and SMACNA's "Architectural Sheet Metal Manual" requirements for dimensions and profiles shown unless more stringent requirements are indicated.

C. SPRI Wind Design Standard: Manufacture and install copings and roof edge flashings tested according to SPRI ES-1 and capable of resisting the following design pressure:

1. Design Pressure: Indicated for location of project.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.6 PERFORMANCE REQUIREMENTS

A. General: Custom fabricated sheet metal flashing and trim to comply with details shown and recommendations in cited sheet metal standard that apply to design, dimensions, geometry, metal thickness, and other characteristics of item required. Fabricate sheet metal flashing and trim in shop to greatest extent possible.

1. Obtain field measurements for accurate fit before shop fabrication.
2. Form sheet metal flashing and trim to fit substrates without excessive oil canning, buckling, and tool marks; true to line, levels, and slopes; and with exposed edges folded back to form hems.
3. Conceal fasteners and expansion provisions where possible. Do not use exposed fasteners on faces exposed to view.

B. Fabricate for applicable requirements of SMACNA "Architectural Sheet Metal Manual" and other recognized industry practices. Fabricate for waterproof and weather-resistant performance; with expansion provisions for running work, sufficient to permanently prevent leakage, damage or deterioration of the work. Form work to fit substrates. Comply with material manufacturer instructions and recommendations for forming material. Form exposed sheet metal work without oil-canning, buckling and tool marks, true to line and levels indicated, with exposed edges folded back to form hems.

C. Expansion Provisions: Form metal for thermal expansion of exposed flashing and trim.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Sealant Joints: Where movable, nonexpansion-type joints are required, form metal to provide for proper installation of elastomeric sealant according to cited sheet metal standard.

E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

F. Fabricate cleats and attachment devices of sizes as recommended by cited sheet metal standard for application, but not less than thickness of metal being secured.

G. Seams: Fabricate nonmoving seams with flat-lock seams. Tin edges to be seamed, form seams, and solder.

H. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.

I. Elastic Expansion Joint Fabrication: Provide manufacturer's standard units of size and type indicated, complete with prefabricated corner and intersection units and splicing materials; with elastic sheet flashing forming the primary joint membrane, in a supported bellows arrangement to be secured to both

sides of expansion joints; with bellows insulated from below with adhesively applied, flexible, closed-cell rubber or plastic not less than 3/8" thick.

J. Bed flanges of work in a thick coat of bituminous roofing cement where required for waterproof performance.

2.7 SHEET METAL FABRICATIONS

A. Roof Edge Flashing (“D” Edge) and Fascia covers/ flashings: Fabricate in minimum 96-inch long, but not exceeding 12-footlong sections. Furnish with 3-inch wide, joint cover plates. Shop fabricate interior and exterior corners. Fabricate from prefinished steel, as specified.

B. Base Flashing: Shop fabricate interior and exterior corners**.** Fabricate from prefinished steel, as specified.

C. Counterflashing and Flashing Receivers: Fabricate from prefinished steel, as specified.

D. Roof-Penetration Flashing: Fabricate from prefinished steel, as specified.

E. Apron, Step, Cricket, and Backer Flashing: Fabricate from prefinished steel, as specified.

F. Drip Edges, fascia panels and soffit panels: Fabricate from prefinished steel, as specified.

PART 3 - EXECUTION

3.1 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Prime substrate if recommended by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps and edges with roller. Cover underlayment within 14 days.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Install sheet metal flashing and trim true to line, levels, and slopes. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
3. Space cleats not more than 12 inches apart. Attach each cleat with at least two fasteners. Bend tabs over fasteners.
4. Install exposed sheet metal flashing and trim with limited oil canning, and free of buckling and tool marks.
5. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals contact each other, or where metal contacts pressure-treated wood or other corrosive substrates, protect against galvanic action or corrosion by painting contact

surfaces with bituminous coating or by other permanent separation as recommended by sheet metal manufacturer or cited sheet metal standard.

1. Coat concealed side of uncoated-aluminum sheet metal flashing and trim with bituminous coating where flashing and trim contact wood, ferrous metal, or cementitious construction.
2. Underlayment: Where installing sheet metal flashing and trim directly on cementitious or wood substrates, install underlayment and cover with slip sheet.

C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at maximum of 10 feet with no joints within 24 inches of corner or intersection.

1. Form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with sealant concealed within joints.
2. Use lapped expansion joints only where indicated on Drawings.

D. Fasteners: Use fastener sizes that penetrate wood blocking or sheathing not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

E. Conceal fasteners and expansion provisions where possible in exposed work and locate to minimize possibility of leakage. Cover and seal fasteners and anchors as required for a tight installation.

F. Seal joints as required for watertight construction. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets with solder to width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work.

1. Do not solder aluminum sheet, metallic coated steel.
2. Do not use torches for soldering.
3. Heat surfaces to receive solder, and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

H. Rivets: Rivet joints in uncoated aluminum where necessary for strength.

3.3 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements, sheet metal manufacturer's written installation instructions, and cited sheet metal standard. Provide concealed fasteners where possible, and set units true to line, levels, and slopes. Install work with laps, joints, and seams that are permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in cited sheet metal standard unless otherwise indicated.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints minimum of 4 inches.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with specified sealant and clamp flashing to pipes that penetrate roof.

G. Soffit panels: Coordinate installation of soffit panels with installation of roofing, fascia, wall finish materials and other items at the top of wall.

3.4 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to cited sheet metal standard unless otherwise indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Through-Wall Flashing: Installation of through-wall flashing is specified in Section 042000 "Unit Masonry."

C. Opening Flashings in Wall Construction: Install continuous head, sill, jamb, and similar flashings to extend minimum of 4 inches beyond wall openings.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder.

C. Clean off excess sealants.

D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer’s written installation instructions.

END OF SECTION 07 60 00

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SECTION 07 72 53 – SNOW GUARDS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1. Performance of the Work of this Section shall comply with Division 00 Prevailing Wage Rate Requirements that apply to this project.

1.2 SUMMARY

A. Section Includes:

1. Prefinished single rail-type, clamp-on, seam-mounted snow guards.

1.3 RELATED SECTONS

A. Section 07 41 13, Standing Seam Roofing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product
B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.
   1. Include details of rail-type snow guards.
   2. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacing, and finish.
C. Samples for selection of colors from manufacturer's full range.
D. Sample Warranty

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports. For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

1.6 WARRANTY

A. Special Warranty on Finishes: Manufacturer agrees to repair finish or replace metal components that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: **20 years from date of Substantial Completion.**

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Provide products from one of the following:

1. Alpine SnowGuards.
2. Sno Shield.
3. VersaGard.
4. Approved Equal

2.2 PERFORMANCE REQUIREMENTS

A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
2. Snow Loads: As indicated on Drawings and for Project location.

2.3 MATERIALS: RAIL-TYPE SNOW GUARDS

A. Seam-Mounted, single rail, clamp-on snow guard system:

1. Description: Snow guard rails with dual parallel rod, anchored to brackets. .
2. Finish: Two-Coat Fluoropolymer or acrylic coated galvalume : AAMA 620 for aluminum. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
   a. Colors: As selected by Architect from manufacturer’s full range to match sheet metal roof.

PART 3 INSTALLATION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.
   1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

3.2 INSTALLATION

A. Install snow guards according to manufacturer's written instructions. Space rows as recommended by manufacturer.
B. Attachment for Standing-Seam Metal Roofing:
   1. Do not use fasteners that will penetrate metal roofing or fastening methods that void metal roofing finish warranty.
   2. Provide clamps which attach the rails to the ribs of the standing-seam metal roof panels.

END OF SECTION 07 72 53

SECTION 07 92 00 - JOINT SEALANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Pourable joint sealants.

B. Related Sections:

1. Division 03, all sections.
2. Division 04, all sections.
3. Division 07, all sections.
4. Division 08, all sections.
5. Division 09, all sections.

1.3 TESTING

A. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521. Provide Field-adhesion test reports.

1.4 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples: For each kind and color of joint sealant required.

C. **Joint-Sealant Schedule**: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

3. Joint-sealant formulation.
4. Joint-sealant color.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field-adhesion test reports.

C. Warranties.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Installer Qualifications: Engage an Installer who has successfully completed within the last 5 years at least 3 joint sealer applications similar in type and size to that of this Project.

C. Single Source Responsibility for Joint Sealer Materials: Obtain materials from a single manufacturer.

1.7 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

C. Warranty Period: Repair or replace with new materials, all defects, faulty materials or workmanship discovered during the guarantee period at no expense to Owner from date of Substantial Completion:
1. Acrylic Latex and Butyl Sealant: 1 year warranty.
2. Silicone Sealant and Adhesive: 20 year warranty.
3. Polyurethane Sealant: 5-year warranty.
4. Fire rated sealants: 10 year warranty.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:
1. Depending on the product, provide the following with the understanding that more than one manufacturer may be used for the different applications:

    a. BASF Building Systems.
    b. Dow Corning Corporation.
    c. GE Advanced Materials - Silicones.
    d. 3M

e. Pecora Corporation.
f. Sika Corporation; Construction Products Division.
g. Vulken / Tremco Incorporated. (RPM)

2.2 MATERIALS, GENERAL

A. Colors: Provide colors as selected by the Architect. There will be several different colors selected for this project particularly for the following:

1. Masonry walls.
2. Concrete floors.
3. Wood surfaces and walls.
4. Flashing and Sheet metal.
5. FRP panels.
6. Storefront/glazing systems.

B. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Single Source Responsibility for Joint Sealer Materials: Obtain materials from one of the manufacturers listed above.

2.3 SILICONE JOINT SEALANTS

A. Neutral-Curing Silicone Joint Sealant: ASTM C 920.

1. Types:
   a. At non-structural glazing of glass: Single component, Type S, ASTM C920, Grade 25.
   b. At metal roofing and sheet Metal Work: Single component, non-sag, ASTM C920-87, Type S, Grade NS, Class 25 (25 percent movement).

c. At plumbing and FRP panels: One part, silicone, mold and mildew resistant, ASTM C920-87, Type S, Grade NS, Class 25 (25 percent movement).

2.4 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant: ASTM C 920.

1. Types:
   a. At perimeter of miscellaneous frames, for wall construction, control and expansion joint, cast stone, and sills Multiple component, polyurethane terpolymer, ASTM C920-87, Type M, Grade NS (non-sag), Class 25 (24 percent movement).
   b. Self-leveling polyurethane sealant for expansion joints in pedestrian traffic bearing surface: Multiple component, self-leveling polyurethane, ASTM C920-87, Type M, Grade P, Class 25 (25 percent movement).

2.5 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Types:
   a. For interior applications only except as follows: One part, non-sag (NS), acrylic latex, ASTM C834-83 (7 1/2 percent movement):Do NOT use this material at applications:
      1. Where joint movement is expected in excess of the material’s specified capabilities.
      2. Where other sealant is otherwise indicated or specified for use.

2.6 BUTYL RUBBER SEALANT

A. Sealant to be used for bedding thresholds and sill plates, one part butyl ASTM C1085-87.

2.7 PREFORMED JOINT SEALANTS

A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, precompressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in precompressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.

1. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:

   a. Dayton Superior Specialty Chemicals.
   b. EMSEAL Joint Systems, Ltd.
   c. Sandell Manufacturing Co.
   d. Schul International, Inc.
   e. Willseal USA, LLC.

2.8 JOINT SEALANT BACKING

A. Cylindrical Sealant Backings: ASTM C 1330, as approved in writing by joint-sealant manufacturer for joint application indicated and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.2 INSTALLATION

A. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

B. Environmental Conditions: Do not proceed with installation of joint sealers until weather conditions are in compliance with manufacturer's recommendations.

C. Joint Width Conditions: Do not proceed with installation of joint sealers where joint widths are less than allowed by joint sealer manufacturer for application indicated.

D. Sequence installation of joint sealers to occur not less than 21 nor more than 30 days after completion of waterproofing, unless otherwise indicated.

E. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

F. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

G. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

H. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

I. Installation of fire-stopping / fire rated sealant: Install sealant, including forming, packing and other accessory materials to fill openings around mechanical and electrical services penetrating floors and walls to provide fire-stops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.

J. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

END OF SECTION 07 92 00

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes hollow-metal doors and frames, including sidelights and glass frames as indicated and scheduled on drawings, and specified herein.

B. Except as noted to the contrary, at locations within the interior of the building, provide manufacturer's standard profile with centered stop, since profile/section details are not shown on the drawings.

C. Door frames and glazed areas shall include integral removable stops at the interior or secure side of the frame. Provide fasteners, anchors, embeds and other attachment appropriate to the back-up wall material shown adjacent to hollow metal work shown on the drawings.

D. Provide 4-7/8" +/- wide frames at all interior walls and 7-3/4" wide frames at exterior door locations.

1.3 RELATED WORK

A. See Section 08 80 00 for Glazing (glass).

B. Exterior hollow metal doors and frames shall be prepared for electro-mechanical components, for security system. Coordinate ½" conduit runs in frames, with an electrical contractor.

C. Refer to all other Division 8 sections which are part and parcel to this section.

1.4 QUALITY ASSURANCE

A. Provide doors and frames complying with Steel Door Institute "Recommended Specifications: Standard Steel Doors and Frames" (SDI-100) and as herein specified.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of door and frame, including details of construction, materials, dimensions, hardware preparation, core, profiles, and finishes.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details showing fabrication and installation of standard steel doors and frames. Include details of each frame type, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.

C. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.6 QUALITY ASSURANCE

A. Tolerances: Comply with SDI 117 "Manufacturing Tolerances Standard Steel Doors and Frames".

B. Provide doors and frames complying with Steel Door Institute "Recommended Specifications Standard Steel Doors and Frames" ANSI/SDI-100 and as herein specified.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage.

B. Store doors and frames at the site under cover. Doors shall be stored in a vertical position. Place units on minimum 4-inches high wood blocking.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements provide steel doors and frames by any member in good standing of the Steel Door Institute.

2.2 MATERIALS

A. Metallic-Coated Steel Sheet: ASTM A 653, Commercial Steel (CS), Type B, with minimum G60 metallic coating (galvanized).

B. Frame Anchors: ASTM A 879, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008 or ASTM A 1011, hot-dip galvanized according to ASTM A 153, Class B.

C. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153.

D. Powder-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.

E. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143.

F. Foamed-in-place (FIP): Polyurethane foam, Class 1 fire resistive rating, flame spread 25.

G. Glazed Openings: Provide glazed framed openings as indicated on Drawings.

1. Glazing: Interior glass shall be ¼" clear laminated glass installed with removable stops.

2. Glazing Accessories:
   a. Sealants: Single component silicone, ASTM C920, Type S, Grade NS, Class 25. Compatible with all contacted surfaces under service conditions as demonstrated by testing and field experience.
   b. Cleaners, primers, sealers: As recommended by sealant or gasket manufacturer.
   c. Setting blocks: Neoprene, EPDM, or silicone blocks; size, shape, and hardness recommended by glass and sealant manufacturers; compatible with substrates and sealants.

2.3 DOORS AND FRAMES

A. **Interior** Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated, cold-rolled steel sheet, 16 gauge minimum thickness.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Polyurethane.

3. Frames:
   a. Materials: Metallic-coated, steel sheet, 16 gauge minimum thickness.
   b. Construction: Face welded.

4. Exposed Finish: Prime.

B. **Exterior** Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At locations indicated in the Door and Frame Schedule.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   b. Thickness: 1-3/4 inches.
   c. Face: Metallic-coated steel sheet, 14 gauge minimum, with minimum A40 coating.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Polyurethane.

3. Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

   Frames:
   a. Materials: Metallic-coated steel sheet, 14 gauge minimum thickness.
   b. Construction: Face welded.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Jamb Anchors:

1. Interior Frames Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042-inch-thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

3. Exterior Frame: Where required, provide minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 FABRICATION

A. Fabricate hollow-metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for metal thickness. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.

B. Hollow-Metal Doors:

1. Exterior Doors:
   a. Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape.
   b. Seal joints in top edges of doors against water penetration.
   c. Provide electrical chase from wire transfer to mortise lock, for future electro-magnetic mortise lock (security system prep).

2. Glazed Lites: Factory cut openings.

C. Hollow-Metal Frames:

1. Provide closed tubular members with no visible face seams or joints, fabricated from the same material as the door frame. Fasten members at crossings and to jambs by butt welding.

2. Provide for wire transfers (1/2” conduit) in exterior door frames for a future security system.

3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

5. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

6. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
   1) Four anchors per jamb from 60 to 90 inches high.
   2) Five anchors per jamb from 90 to 96 inches high.

b. Post-installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c. Even at new construction, provide except where noted to the contrary to facilitate future replacement.

7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers.
   a. Drill stop in strike jamb to receive three door silencers

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Provide for wire transfers (½" conduit) for future security system.
3. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.
4. Doors reinforcement shall be reinforced, mortised, drilled and tapped for all hardware. Fabricate according to ANSI/SDI A250.6 with reinforcing plates and concealed stiffeners from same material as door face sheets.
5. Frame Reinforcement: Frames shall be reinforced, mortised, drilled and tapped for all hardware. Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with mitered hairline joints.

1. Glazed Lites: Provide independent fixed stops and moldings welded on secure side of hollow-metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.

2.6 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard rust-inhibiting primer.

1. Shop Primer: SDI A250.10.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
   a. Install frames with removable stops located on secure side of opening.
   b. Install door silencers in frames before grouting.
   c. Remove temporary braces necessary for installation only after frames have been properly set and secured.
   d. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   e. Field applies bituminous coating to backs of frames that will be filled with grout containing anti-freezing agents.
   f. Set all exterior doorframes so hinge pivot will allow door to swing 180 degrees unless indicated otherwise.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

3. Metal-Stud Partitions: Solidly pack foamed-in-place insulation inside frames.

4. Interior Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Concrete Walls: Solidly fill space between frames and concrete and masonry with foamed-in-place insulation.

6. Exterior Concrete or Masonry Construction: Secure frames in place with expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces. Solidly fill space between frames and concrete with foamed-in-place insulation.

7. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

   a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
   b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
   c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
   d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.

2. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.

3. At Bottom of Door: 3/4 inch plus or minus 1/32 inch.

4. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

C. Glazing: Comply with installation requirements in Section 08 80 00 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 08 11 13

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SECTION 08 36 00 - SECTIONAL OVERHEAD DOORS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 DESCRIPTION OF WORK:

A. Section includes commercial quality, motorized, sectional overhead doors including all accessories, as shown on drawings and specified herein, and as follows:

1. Overhead sectional doors with a combination of solid insulated sections and glazed aluminum-framed sections, with motor driven operation, Kynar finish.

B. Section includes all tracks, operators, switches and accessories as provided herein.

C. Operation for each door shall be as follows:

1. Internal 3 button wall-mounted switch shall be provided at each overhead door.
2. 4 button remote (total of 5).
3. Supplementary manual override operation at each door.

D. Provide trolley operators at all locations.

E. Provide 3" track (rollers and hardware) for all doors in configurations shown on the drawings.

E. Vision panels: Clear insulated laminated, tempered glass.

F. This section includes controls, wiring, connections, manual override, closing operation, photo-eye, connections, emergency reverse eyes and other components to complete the work related to the overhead doors.

G. If horizontal struts / reinforcing is required at the vision panels, by the manufacturer, this must be shown on the shop drawings or this will not be considered acceptable for aesthetic reasons: the manufacturer shall warrant the stability and structural integrity of the door regardless.

1.3 QUALITY ASSURANCE:

A. Provide sectional overhead doors as a complete unit produced by one manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators and installation accessories, to suit openings and head room allowable.

B. Wind Loading: At exterior doors, design and reinforce sectional overhead doors to withstand a 20 lb. per sq. ft. wind load.

C. Approval: Manufacturers not listed herein shall provide evidence that they are able to meet the intent of the specifications. Provide a full submittal with a listing of five similar projects of similar size and complexity (including specifications for each), list of references and all other requested materials.

D. Installer: Installer shall be approved and authorized by the manufacturer.

E. Pre-installation conference: Schedule a pre-installation conference prior to installation of door systems. Establish necessary working conditions and related work for a correct installation.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's product data, roughing-in diagrams, and installation instructions for each type and size of overhead door. Provide material on vehicle loop detectors, transmitters, receivers, proximity sensors and other accessories. Include manufacturer's operating instructions and maintenance data.

B. Shop Drawings: Submit shop drawings for special components and installations which are not fully dimensioned or detailed in manufacturer's data. Indicate all reinforcing, stiles, vision panel size, reinforcement and related items. Include 50,000 cycle guarantee with shop drawings submittal.

C. Samples: Submit 6" by 6" samples of custom finish color/texture.

D. Maintenance data and manuals at closeout.

1.5 WARRANTY:

A. Provide written warranty to cover the following covering the following based on “normal use” by the owner:

1. 1 year coverage of labor and materials for the entire door system
2. 2 year coverage of labor and materials for replacement of any door panel that has rusted.
3. 5 year coverage for delamination of panels, materials- only delivered to the project site
4. 10 year coverage for rusting of panels, materials- only shipped to the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with all specified requirements, including gages, qualities, accessories and paint finish, provide all doors from one of the following manufacturers:

Clopay Door
Midland Door
Overhead Door
Raynor Door
Wayne Dalton
North Central Door
Other manufacturers meeting this specification, as approved

2.2 MATERIALS:

A. Insulated doors: At all locations, 20 gage G60 galvanized exterior steel face sheets, with a minimum yield strength of 33,000 psi, and a minimum G60 zinc coating complying with ASTM A 525.

B. Flush, non-textured, flat panel doors shall have a powder coat finish in custom color: to match selection of framing for glazed sections.

C. Framing for glazed doors: Extruded aluminum frame stiles and rails shall be provided with Custom Color finish, color as selected by the Architect. Exterior surfaces to be beveled to for drainage.

D. End Stiles: Minimum 16 gauge separated from skin with vinyl thermal break, double end stiles.

E. Insulation at insulated steel door panels: At all insulated doors, the minimum thickness of each door shall be 1-7/8". The insulation shall be the manufacturer's standard, type as recommended by the manufacturer, bonded to steel face sheets. Panels shall be of adequate integrity, of the size shown, to perform under daily use without warping, racking or failing with daily use.

F. Insulation section shall have an R-value minimum of 9.0.

G. Exterior door panel sections shall include continuous dual weather-stripping, and interlock design at seams.

H. Glazing/glass: Insulated vision panels shall be provided at locations shown on the drawings. Refer to Section 08800 for insulated glass requirements. Provide sealed double-glazed glass units where shown of 1/2" minimum thickness, insulated clear glass.

2.3 TRACKS, SUPPORTS AND ACCESSORIES:

A. Tracks: Provide manufacturer's 3" 12 gauge heavy duty galvanized steel track system at all doors. Provide complete track assembly including brackets, bracing and reinforcing for rigid support of ball bearing roller guides, for required door type and size.

B. Refer to the drawings for types of tracks and clearance as required on this project.

C. Track Reinforcement and Supports: Provide galvanized steel track reinforcement and support members. Secure, reinforce and support tracks as required for size and weight of door to provide strength and rigidity, and to ensure against sag, sway, and detrimental vibration during opening and closing of doors.

D. Support and attach tracks at opening jambs with continuous angle welded to tracks and attached to wall. Support horizontal (ceiling tracks) with continuous angle welded to track and supported by laterally-braced attachments to overhead structural members at curve and end of tracks.

E. Weather Seals: At all doors, provide heavy duty, continuous header and side seals anchored to the top panel and side jamb, especially designed to prohibit wind and rain from entering through closed door. Provide color options for Architect's selection.

F. Section seal to be continuous integral, dual vinyl seals at each panel intersection. Panels shall be designed with interlocking construction to hold seals.

G. Bottom weather-strip to be flexible bulb type vinyl or neoprene section held in aluminum retainer, compressible to create a weather tight seal between door and floor.

2.4 HARDWARE:

A. Provide heavy-duty, rust-resistant hardware, with galvanized or cadmium-plated or stainless steel fasteners, to suit type of door.

B. Hinges: Provide heavy steel hinges at each end stile and at each intermediate stile, per manufacturer's recommendations for size of door. Attach hinges to door sections through stiles and rails with bolts and lock nuts or lock washers and nuts. Use rivets or self-tapping fasteners

where access to nuts is not possible. Provide double-end hinges, where required, for doors exceeding 16'-0" in width, unless otherwise recommended by door manufacturer.

C. Rollers: Provide Magnum type heavy-duty 3" rollers, with double sealed steel ball bearings (minimum ten 1/4" balls per roller) in case-hardened chromium plated steel raceways with stainless steel stems mounted with varying projections to suit slope of track. Tires to be UHMW type. These to be used at all doors. Provide roller length suitable for the dual roller brackets.

D. Roller brackets: Provide dual galvanized roller brackets.

2.5 COUNTERBALANCING MECHANISMS:

A. Torsion Spring: high cycle, 50,000 cycle type at all doors, certified by the manufacturer, with 3 greaseable pillow block bearing per shaft. Spring design shall be replaceable, no longer than 72" length. Hang door assembly for operation by torsion spring counterbalance mechanism, consisting of adjustable tension tempered steel torsion springs mounted on a case-hardened steel shaft, and connected to door with galvanized aircraft type lift cable.

B. Provide cast aluminum or grey iron casting cable drums, grooved to receive cable. Mount counterbalance mechanism with manufacturer's standard ball-bearing brackets at each end of shaft with one additional mid-point bracket for shafts up to 16' long and 2 additional brackets at 1/3-points to support shafts over 16' long, unless closer spacing recommended by door manufacturer.

C. Include a spring-loaded steel or bronze cam mounted to bottom door roller assembly on each side, designed to stop door automatically if either cable breaks. Provide either a compression spring or leaf spring bumper installed at end of each horizontal track to cushion door at end of opening operation.

2.6 DOOR OPERATOR, CONTROLS AND ACCESSORIES:

A. Trolley operators: At all exterior door locations, provide heavy duty commercial duty operator enclosed equal to Liftmaster GT Gearhead Trolley Operator Logic 5.0. Industrial Duty Jack Shaft. Refer to “electric motors” below for additional specifications.

1. Provide special NEMA Type 4x enclosure at wash bay location.

C. Electric Motors: Provide 1 horsepower (or size as recommended by the manufacturer) at all exterior doors 208 Volt, three phase *(this must be verified with electrical)* heavy duty, high starting torque, reversible, constant duty, Class A insulated electric motors with overload protection, sized to move door in either direction, from any position, at not less than 6" or more than 12" per second. Include all overload protection, limit switches and accessories as required.

D. Automatic Reversing Control: Provide safety switch, extending full width of door bottom, and located within neoprene or rubber astragal mounted to bottom door rail.

1. Provide photo eye with emitter located high and low (with heights and locations verified by the owner). Unit shall be UL listed with 115 voltage AC power: Sun-X-Thru Beam or see 012500 for Substitution Procedures. Heights must be verified prior to installation.

E. Door Controls: Performance specification on controls, accessories and features: System accessories and features shall be provided as recommended by the door manufacturer. Contractor of this section shall provide all necessary controls, equipment, accessories and features to the following performances:

1. Wall Mounted switches: Provide the 3 button momentary switch at every door. All doors shall include the switch at the interior side of each door only.

2. Provide 4 button control for use with the 4 overhead doors. Provide Liftmaster 894LT. Total of controls.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install doors, tracks, and operating equipment complete with necessary hardware, jamb and head mold stops, anchors, inserts, hangers, and equipment supports in accordance with final shop drawings, manufacturer's instructions and as herein specified.

1. Prior to installation, coordinate placement of track, door and accessories with other subcontractors, including mechanical, to avoid conflicts.

2. Fasten vertical track assembly to framing at not less than 24" o.c. Hang horizontal track from structural overhead framing with angle or channel hangars, welded and bolt-fastened in place. Provide sway bracing, diagonal bracing, and reinforcing as required for rigid installation of track and door operating equipment.

3. Upon completion of installation, including work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist, or distortion and fitting weather tight for entire perimeter.

B. Contractor shall adjust or replace materials until specified minimums are met or exceeded. In addition, contractor shall promptly repair door defects until unit is working properly.

C. Assist Owners with operation and maintenance guidelines to the satisfaction of the Architect and Owner.

END OF SECTION 08 36 00

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SECTION 08 41 13 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes aluminum stick framing system for fixed window units and entrance areas on the project as shown on the drawings.

B. Section also includes entrances made of aluminum and glass.

C. Storefront design (refer to drawings and schedules for more information):

1. 4-1/2” depth framing members.

D. Refer to Section 08 80 00 for glazing used in conjunction with this section.

E. The Owner will be providing electronic security at certain doors. Refer to the schedule for locations. Refer to Division 26 for the electrical work which is a part of the project.

1.3 RELATED WORK

A. Related Sections:

1. 08 70 00- Hardware
2. 08 80 00- Glazing
3. 07 92 00- Joint Sealants
4. 08 44 13- Aluminum Framed Curtain Walls
5. Division 26, Electrical

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include plans, elevations, sections, full-size details, and attachments to other work.

1. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples: For each exposed finish required, showing full range of color change.

D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: NFRC-certified energy performance values from manufacturer.

B. Product test reports.

C. Field quality-control reports.

D. Sample warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer. 5 years minimum successful experience in the installation of systems similar to those required.

B. Manufacturer's Qualifications: Provide products produced by a single manufacturer with not less than 5 years successful experience in the fabrication of assemblies of the type and quality required.

C. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing.

D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

1. Do not change intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.8 WARRANTY

A. Special Warranty: Manufacturer and Installer agree to repair or replace components (including reglazing) of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period. Failures include, but are not necessarily limited to structural failures including excessive deflection, excessive leakage or air infiltration, faulty operation, and deterioration of metals, metal finishes and other materials beyond normal weathering. Warranty shall include thermal-break: shrinkage, cracking and leakage.

1. Warranty Period: Three years, minimum, from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: The system provided under this section is based on Old Castle Building Envelope system.

B. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:

1. CRL (US Aluminum)
2. Kawneer North America.
3. Old Castle
4. Tubelite
5. Approved equal.

2.2 MATERIALS

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing Construction, Thermally broken
2. Interior Framing Construction, Non-thermal, except at entry vestibules.
3. Glazing System: Retained mechanically with gaskets on four sides.
4. Glazing Plane: Front-set.
5. Finish: Dark bronze Kynar finish
6. Fabrication Method: Field-fabricated stick system.
7. 1-3/4” (or 2” nominal) width by 6” (minimum) depth framing members at exterior entrances, with glazing front-set.
8. 1-3/4” (or 2” nominal) width by 4-1/2” depth framing members at all other locations, with glazing front-set.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brake metal: Infill sections, base pieces and non-structural components shall be minimum 1/8" thick aluminum break metal, all finished to match framing.

D. Materials to include corner sections/profiles, door inserts, bottom track sections, angles, bars, retainers, various supports and fastening systems, and all other components for a complete system.

E. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with non-staining, nonferrous shims for aligning system components.

F. Other Materials:

1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.

2. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select

surface preparation methods according to recommendations in SSPC-SP COM, and prepare surfaces according to applicable SSPC standard.

a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

3. Fasteners: Provide fasteners of aluminum, nonmagnetic stainless steel, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum components, hardware, anchors and other components. Provide concealed fasteners wherever possible.

4. Concealed Flashing: 26 gage minimum dead-soft stainless steel, or 0.026" minimum extruded aluminum of alloy.

5. Concrete / Masonry Inserts: cast-iron, malleable iron, or hot-dip galvanized steel complying with ASTM A 386.

2.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Structural Loads:

1. Wind Loads: As indicated on Drawings, or as specified herein, using most stringent requirements.
2. Other Design Loads:

C. Deflection of Framing Members: At design wind pressure, as follows:

1. Wind loading: Uniform pressure of 20 psf inward and 20 psf outward when tested in accordance with ASTM E 330. Design system in accordance with UBC exposure "B" (Unless more stringent standards indicated elsewhere, or as required by code).

2. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane not exceeding 1/175 of the glass edge length for each individual glazing liteor an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.

3. Deflection Parallel to Glazing Plane: Limited to 1/360 of clear span or 1/8 inch, whichever is smaller.

a. Operable Units: Provide a minimum 1/16-inch clearance between framing members and operable units.

4. Cantilever Deflection: Where framing members overhang an anchor point, as follows:

    a. Perpendicular to Plane of Wall: No greater than 1/240 of clear span plus 1/4 inchfor spans greater than 11 feet 8-1/4 inches or 1/175 times span, for spans less than 11 feet 8-1/4 inches.

D. Structural: Test according to ASTM E 330 as follows:

1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:

1. Fixed Framing and Glass Area:

    a. Maximum air leakage of 0.06 cfm/sq. ft.at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

2. Entrance Doors:

    a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).
    b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft. (75 Pa).

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft..

G. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas at exterior locations shall have U-factor of 0.34.
2. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 45 as determined according to NFRC 500.

H. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.4 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: 1-3/4-inchoverall thickness, with minimum 0.125-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: ADA Compliant, Wide stile; 5 or 6-inch nominal width.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide removable glazing stops on inside of door.
b. Interior doors shall have single pane tempered glass.
c. Exterior and vestibule doors shall have 3/4” or 1” double pane insulated tempered or laminated glass.

2.5 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. General: Provide entrance door hardware for each entrance door to comply with requirements in this Section and Section 087100.

C. Owner will provide key card security system for entrance doors.

D. Provide Manufacturer’s standard weatherstripping, sweep strips and finger guards, with any metal components finished in color to match framing system (as a part of this section). Refer to hardware section, 087100 for all other requirements for complete set of hardware components.

1. Compression Weather-Stripping: Molded neoprene complying with ASTM D 2000 or molded PVC complying with ASTM D 2287.

2. Sliding Weather-Stripping: Replaceable weather-stripping of wool, polypropylene, or nylon woven pile, with nylon fabric or aluminum strip backing, complying with AAMA 701.2.

3. Provide finger guards of collapsible neoprene or PVC gasketing securely anchored to frame.

4. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

5. Opening-Force Requirements:

a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion.
b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

2.6 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

D. Sealants used inside the weatherproofing system shall have a maximum VOC content of **250** g/L.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Field Measurements: Field measure before fabrication to ensure proper fitting of work; show measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay in the work. Where necessary, proceed with fabrication without field measurement, and coordinate fabrication tolerances to ensure proper fit.

C. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding. Comply with AWS recommendations, grind exposed welds smooth and restore mechanical finish.

D. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing.
6. Reinforcing: Install reinforcing as required for hardware and necessary for performance requirements, sag resistance and rigidity.
7. Dissimilar Metals: Separate dissimilar metals with zinc chromate primer, bituminous paint, or other separator to prevent corrosion.
8. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

E. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Manufacturer’s standard dark bronze anodized aluminum finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.

4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 08 80 00 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

H. Clean the completed system, inside and out, promptly after installation, exercising care to avoid damage to coatings.

I. Institute protective measures required throughout the remainder of the construction period to ensure that aluminum entrances and storefronts will be without damage or deterioration, other than normal weathering, at time of acceptance.

END OF SECTION 08 41 13

SECTION 08 45 13 – STRUCTURED POLYCARBONATE PANEL ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.2 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.3 SUMMARY

A. This section includes aluminum framing system with polycarbonate panel assemblies and associated components for a complete system.

B. Refer to section 07 92 00 for sealants associated and used as a part of this system.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide a complete system consisting of aluminum frame and polycarbonate glazing capable of withstanding loads as defined by the local governing codes having jurisdiction where the system is to be installed without failure. Failure to include the following:

1. Deflection exceeding specified limits.
2. Thermal stresses transferred to the building structure.
3. Framing members transferring stresses, including those caused by thermal and structural movement to glazing.
4. Weakening of fasteners, attachments and other components.

B. Structural Loads: Provide structural polycarbonate panel assemblies, including anchorage, capable of withstanding the effects of the following design loads:

1. Wall Loads:

a. Positive Wind Load: 20 psf.

b. Negative Wind Load: 20 psf.

C. Water Infiltration: No uncontrolled leakage in accordance with ASTM E 331, at a test pressure of 7.5 psf.

D. Air Infiltration: Will not exceed 0.05 cfm per square foot of glazing at a differential pressure of 1.57 psf and not to exceed 0.07 cfm per square foot at 6.24 psf in accordance with ASTM E 283.

E. Uniform Static Air pressure Difference: No damage at [75] psf in accordance to ASTM E 331.

F. Impact Testing:

1. Small Missile in accordance with ASTM E 1886

G. Flammability:

1. Panel shall have a CC1 fire rating classification when tested in accordance with ASTM D 635 or equivalent.
2. The panel shall have a Class A flame Spread and smoke developed rating when tested in accordance with ASTM E 84.
3. Panel shall have an ignition temperature of 896 degrees F when tested in accordance with ASTM D 1929.

1.5 SUBMITTALS

A. Product Data Sheets: Submit manufacturer's product data, including details of construction and installation, materials and finish and installation instructions applicable to the configuration.

B. Shop Drawings:
   1. Shall include Plans and / or elevations and details of the system and its installation. Flashing sealants and anchorage shall be clearly indicated.
   2. Shall note gauges of brake metal, the finish on the framing and any other information required to properly describe and install the system.

C. Samples for Selection: Submit manufacturer's samples for each glazing type (4" x 6"), framing system (4"), finish, and color.

D. Warranty: Submit manufacturer's standard warranty.

1.6 WARRANTY

A. Warranty: Written warranty, executed by the manufacturer agreeing to repair components system failure of materials or workmanship within the specified warranty period. Failure includes, but are not limited to the following:

   1. Structural failures.
   2. Failure of systems to meet performance requirements.
   3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   4. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of the glazing system from sources other than condensation, resulting from defects in the Series 3500 system materials or workmanship. [Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage]. Water leakage resulting from improper installations not part of the warranty.

B. System Warranty: Provide written warranty from manufacturer agreeing to replace materials that exhibit defects from manufacturing or fabrication that contribute to water leakage (as defined above) or Structural failure for a period of **2 years.**

C. Polycarbonate Warranty: Provide written warranty from manufacturer agreeing to repair or replace work that has or develops defects in the polycarbonate panels. "defects" is defined as abnormal aging or deterioration, for a period of **10 years.**

D. Finish Warranty: Provide written warranty from manufacturer agreeing to repair or replace work with finish defects. "Defects" is defined as peeling, chipping, chalking, fading, abnormal aging or deterioration and failure to perform as required, for a period of **5 years.**

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Subject to specified requirements, provide system from the following:

   1. Duo-Guard Industries.
   2. Approved equal.

B. Basis-of-Design: Documents are based on the Series 3500 40mm Polycarbonate Glazing System by Duo-Gard Industries Inc.

2.2 MATERIALS

B. Framing System:

   1. Provide extruded aluminum alloy of 6063-T5, 6005-T5 or 6061-T6 ASTM B 221. All sections shall be formed true to detail and free from defects impairing appearance, strength and durability. Provide integral weep holes in factory supplied sill extrusions and welded corner assemblies to provide end dams.

2. Thermally improved perimeter aluminum framing members, exclusive of cover caps, shall incorporate minimal thermal bridge location only at fastener locations typically 18" on center unless otherwise noted. Thermal isolation is created through the practice of isolating the components through non-thermally conductive materials.

C. Glazing Gaskets:

1. Shall be elastomeric, having low friction where in contact with the glazing panel.
2. Shall be compatible with the polycarbonate glazing panel.

D. Fasteners:

1. In general, concealed fasteners are to be used for all aluminum framing unless noted in submittal drawings.
2. In system construction, the use of adhesives and sealants are not allowed.
3. Where exposed, fasteners shall be stainless steel with stainless steel backed neoprene washers
4. Concealed fasteners may be stainless steel or zinc-plated steel in accordance with ASTM specifications A165-55 or A164-55.
5. Bolts, anchors and other fastening devices shall be as required for the strength of the connections and shall be suitable for conditions encountered. Washers shall be of the same material as the fasteners.

E. Flashing:

1. Minimum of .040" thick Aluminum.
2. Factory formed to project profile(s) in 10-ft. lengths, whenever practical, to allow for field trimming and fitment to suit as-built conditions.
3. The finish on this flashing metal shall match as closely as possible the finish on the aluminum framing members.
4. Concealed flashing: Manufacturer's standard corrosion resistant, non-staining, non-bleeding flashing compatible with adjacent materials
5. Exposed flashing: Aluminum sheet alloy of 5005-H34, thickness as required for proper performance per application.

F. Polycarbonate Glazing Panels:

1. The extruded panels shall be uniform in color with an integral extruded multi-cell core. The panel's exterior and interior face shall be interconnected and spaced apart by continuous ribs, perpendicular and/or be diagonal "cross" pattern between the exterior and interior face. The space between the faces, in cross section, shall be divided into multiple adjacent intermediate walls parallel to each other. Dual panel and dual wall system with an interstitial space shall not be permitted.

2. Panels shall consist of a polycarbonate resin with a permanent, co-extruded, ultraviolet protective layer on both faces of the panel. This protective layer shall be co-extruded by the manufacturer during the original manufacturing process of the panel and shall be a permanent, non-removable, part of the panel. Post applied coating or films of dissimilar materials are unacceptable and not allowed.

3. Provide Modular, Tongue and Groove interconnecting, multi-walled polycarbonate panel as follows:
   a. Thickness: 40mm (1.57 or 1-9/16 inch) nominal.
   b. Color shall be selected from manufacturer's standard available colors by the Architect.
   c. Extruded one single length for each glazing area. Transverse connections are not acceptable.

2.3 FABRICATION

A. Fabricate framing components as follows:

1. Factory prepare, fit and assemble components where practical prior to delivery.
2. Fabricate components that, when assembled, will fit precisely and accurately with mitered or coped ends producing hairline joints free of burrs and distortion.
3. Fabricate components to accommodate thermal expansion and contraction, field adjustment and provide minimum clearance and shimming for proper glazing system installation and performance.
4. Fabricate components to properly drain water passing through joints; drain condensation and moisture occurring and mitigating within glazing system to the exterior through internal guttering and a weep system.

5. Fabricate components to ensure that glazing is properly isolated for low friction thermal and physical movement within the glazing system.
6. Fabricate components with straight, sharp profiles and edges free from defects or deformations before finishing.
7. Fabricate, fit and assemble components to the greatest extent practical before finishing.
8. Reinforce components and member as required to retain fastener thread and engagement.
9. Fabricate glazing retainer bars for fastener placement at 12" on center.
10. Weld components before finishing and in concealed location to greatest extent practical to minimize distortion and/or discoloration.

B. Provide aluminum framing to the longest lengths possible to minimize splice joints. Splice joints will be sealed and locked with at least a six inch offset between frame components.

C. Provide welded corner assemblies were practical.

D. Prepare aluminum framing components for anchors and connection devices, fasteners and hardware.

E. Glazing Panels:

1. Polycarbonate panels will be extruded and fabricated in one single length for each glazing area. Transverse panel connections are not acceptable. One glazing area is defined as the area between 2 adjacent tongue and groove joints, from head to sill framing.
2. Glazing panels will be shop fabricated to a "rough" size allowing easy field cutting/fitting to accommodate proper thermal movement within aluminum framing based on seasonal conditions at time of installation.
3. Basis of design is: U-value .26 and SHGC .35.
4. The internal cellular structure of the glazing panel will be properly blown clean of any manufacturing debris prior to shipment and installation.

2.4 ALUMINUM FINISHES

A. General: Comply with NAAMM "Metal Finish Manual" recommendations for application and designations of finishes.

B. Finish designations prefixed by AA conform to the system for designations of aluminum finished established by the Aluminum Association.

1. 50% Fluoropolymer PVDF "Kynar" Finish: complying with AAMA 2604, standard color.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive translucent glazing. Notify Contractor / Architect of conditions that would adversely affect installation or subsequent utilization of daylighting. Do not proceed with installation until unsatisfactory conditions are corrected.
B. Ensure supports to receive translucent insulated daylighting are clean, flat, level, plumb, square, accurately aligned, and correctly located.
C. All submitted opening sizes, dimensions and tolerances are to be field verified by the installer unless otherwise stipulated.
D. Installer to examine site conditions to verify readiness. Notify general contractor or owner about any defects requiring corrections, including but not limited to improperly sloping sill substrates and uneven planar substrates. Do not work until conditions are satisfactory

3.2 INSTALLATION

A. Install components in strict accordance with manufacturer's instructions and approved shop drawings. Use proper fasteners and hardware for material attachments as specified.
B. Use methods of attachment to structure which include provisions for thermal movement.
C. Glazing shall be installed in accordance with panel and system manufacturer's guidelines.

D. Install flashing, fasteners, hardware, gaskets, joint sealants, and glazing materials required for a complete, weathertight installation.
E. Remove all protective coverings on polycarbonate panels during or immediately after installation.
F. Apply joint sealants in accordance to sealant and system manufacturer's guidelines. Use sealant approved by system manufacturer as specified previously in specification.
G. Repair any minor installation marks or damage to metal finish in accordance with manufacturer's instructions and as approved by Architect. Remove and replace damaged components that cannot be successfully repaired as determined by Architect.

3.4 CLEANING

A. During installation, protect exposed surfaces against accumulation of paint, caulking, disfiguration and damage.
B. Interior glazing surfaces shall be cleaned as the panels are being installed. The exterior shall be cleaned as each phase of the work is completed.
C. Remove excess joint sealant in accordance with sealant manufacturer's instructions.
D. Clean inside and outside of glazing panels immediately after installation and after joint sealants have cured.
E. Follow panel manufacturer's instructions when cleaning exposed panel surfaces. Clean polycarbonate and frame at time of installation.
F. Clean glazing panels in accordance with panel and system manufacturer's instructions and guidelines.

3.5 PROTECTION

A. Protect installed translucent insulated daylighting from damage during construction.
B. Remove and replace damaged daylighting components as determined by Architect.

END OF SECTION

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SECTION 08 71 00 - DOOR HARDWARE

PART 1 - GENERAL

1.1 CONDITIONS

A. Conditions of the contract (General and Supplementary Conditions) and Division One General Requirements, govern the work of this section.

B. This section includes all material, and related service necessary to furnish all finish hardware indicated on the drawings, or specified herein.

C. Furnish UL listed hardware for all labeled and 20 min. openings in conformance with the requirements for the class of opening scheduled. Underwriters' requirements shall have precedence over specification where conflicts exist.

D. All work shall be in accordance with all applicable state and local building codes. Code requirements shall have precedence over this specification where conflicts exist.

1.2 WORK INCLUDED

A. This section includes the following:

1. Furnish door hardware (for hollow metal, wood and aluminum doors) specified herein, listed in the hardware schedule, and/or required by the drawings.
2. Cylinders for Aluminum Doors
3. Thresholds and Weather-stripping (Aluminum frame seals to be provided by aluminum door supplier)
4. Electro-Mechanical Devices
5. Access Control components and or systems specified within this section.

B. Where items of hardware are not definitely or correctly specified and is required for the intended service, such omission, error or other discrepancy should be directed to the Architect prior to the bid date for clarification by addendum. Otherwise furnish such items in the type and quantity established by this specification for the appropriate service intended.

1.3 RELATED WORK IN OTHER SECTIONS

A. This section includes coordination with related work in the following sections:

1. Division 6 Section "Finish Carpentry".
2. Division 6 Section "Cabinet Hardware"
3. Division 8 Section "Hollow Metal Doors and Frames".
4. Division 8 Section "Wood Doors"
5. Division 8 Section "Aluminum Entrances and Storefronts"
6. Division 28 Sections "Electrical".

1.4 REFERENCES

A. Publications of agencies and organizations listed below form a part of this specification section to the extent referenced.

1. DHI - Recommended Locations for Builders' Hardware.
2. NFPA 80 - Standards for Fire Doors and Windows.
3. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
4. UL - Building Material Directory.
5. DHI - Door and Hardware Institute
6. WHI - Warnock Hersey
7. BHMA - Builders Hardware Manufacturers Association
8. ANSI – American National Standards Institute
9. IBC 2012 - International Building Code 2012 Edition (as amended by local building code)

1.5 SUBMITTALS

A. Within ten days after award of contract, submit detailed hardware schedule in quantities as required by Division 1 - General Conditions.

B. Schedule format shall be consistent with recommendations for a vertical format as set forth in the Door & Hardware Institute's (DHI) publication "Sequence and Format for the Hardware Schedule". Hardware sets shall be consolidated to group multiple door openings which share similar hardware requirements. Schedule shall include the following information:

1. Door number, location, size, handing, and rating.
2. Door and frame material, handing.
3. Degree of swing.
4. Manufacturer
5. Product name and catalog number
6. Function, type and style
7. Size and finish of each item
8. Mounting heights
9. Explanation of abbreviations, symbols, etc.
10. Numerical door index, indicating the hardware set/ group number for each door.

C. When universal type door closers are to be provided, the schedule shall indicate the application method to be used for installation at each door: (regular arm, parallel arm, or top jamb).

D. The schedule will be prepared under the direct supervision of a certified Architectural Hardware Consultant (AHC), or certified Door Hardware Consultant (DHC) employed by the hardware distributor. The hardware schedule shall be signed and embossed or stamped with the DHI certification seal of the supervising AHC or DHC. The supervising AHC or DHC shall attend any meetings related to the project when requested by the architect.

E. Check the specified hardware for suitability and adaptability to the details and surrounding conditions.

F. Review drawings from related trades as required to verify compatibility with specified hardware. Indicate unsuitable or in compatible items, and proposed substitutions in the hardware schedule.

G. Provide documentation for all hardware to be furnished on labeled fire doors indicating compliance with positive pressure fire testing UL 10C.

H. Furnish manufacturers' catalog data for each item of hardware in quantities as required by Division 1 - General Conditions.

I. Submit a sample of each type of hardware requested by the architect. Samples shall be of the same finish, style, and function as specified herein. Tag each sample with its permanent location so that it may be used in the final work.

J. Furnish with first submittal, a list of required lead times for all hardware items.

K. After final approved schedule is returned, transmit corrected copies for distribution and field use in quantities as required by Division 1 - General Conditions.

L. Furnish approved hardware schedules, template lists, and pertinent templates as requested by related trades.

M. Furnish necessary diagrams, schematics, voltage and amperage requirements for all electro-mechanical devices or systems as required by related trades. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

N. After receipt of approved hardware schedule, Hardware supplier shall initiate a meeting including the owner’s representative to determine keying requirements. Upon completion of initial key meeting, hardware supplier shall prepare a proposed key schedule with symbols and abbreviations as set forth in the door and hardware institute’s publication “Keying Procedures, Systems, and Nomenclature”. Submit copies of owner approved key schedule for review and field use in quantities as required by Division 1 – General Conditions. Wiring diagrams shall be included in final submittals transmitted for distribution of field use.

1.6 QUALITY ASSURANCE

A. Manufacturers and model numbers listed are to establish a standard of function and quality. Similar items by approved manufacturers that are equal in design, function, and quality, may be considered for prior approval of the architect, provided the required data and physical samples are submitted for approval as set forth in Division One General Requirements.

B. Where indicated in this specification, products shall be independently certified by ANSI for compliance with relevant ANSI/BHMA standards A156.1 - A156.36 – Standards for Hardware and Specialties. All products shall meet or exceed certification requirements for the respective grade indicated within this specification. Supplier shall provide evidence of certification when requested by the architect.

C. Obtain each type of hardware (hinges, latch & locksets, exit devices, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Electrical drawings and electrical specifications are based on the specific electrified hardware components specified in hardware sets. When electronic hardware components other than those indicated in hardware sets are provided, the supplier shall be responsible for all costs incurred by the design team and their consultants to review, and revise electrical drawings and electrical specifications. Supplier shall also be responsible for any additional costs associated with required changes in related equipment, materials, installation, or final hook up to insure the system will operate and function as indicated in the construction documents, including hardware set operational / functional descriptions.

E. All hardware items shall be manufactured no earlier than 6 months prior to delivery to site.

F. Hardware supplier shall be factory trained and certified by the manufacture to provide and support all computer managed locks and system components.

G. Installation of hardware shall be installed or directly supervised and inspected by a skilled installer certified by the manufacturer of locksets, door closers, and exit devices used on the project, or with not less than 3 years' experience in successful completion of projects similar in size and scope.

H. Provide hardware for all labeled fire doors, which complies with positive pressure fire testing UL 10C.

I. Comply with all applicable provisions of the standards referenced within section 1.4 of this specification.

J. Hardware supplier shall participate when reasonably requested to meet with the contractor and or architect to inspect any claim for incorrect or non-functioning materials; following such inspection, the hardware supplier shall provide a written statement documenting the cause and proposed remedy of any unresolved items.

1.7 DELIVERY, STORAGE AND HANDLING

A. Hardware supplier shall deliver hardware to the job site unless otherwise specified.

B. All hardware shall be delivered in manufacturers' original cartons and shall be clearly marked with set and door number.

C. Coordinate with contractor prior to hardware delivery and recommend secure storage and protection against loss and damage at job site.

D. Contractor shall receive all hardware and provide secure and proper protection of all hardware items to avoid delays caused by lost or damaged hardware. Contractor shall report shortages to the Architect and hardware supplier immediately after receipt of material at the job site.

E. Coordinate with related trades under the direction of the contractor for delivery of hardware items necessary for factory installation.

1.8 PRE-INSTALLATION MEETING

A. Schedule a hardware pre-installation meeting on site to review and discuss the installation of continuous hinges, locksets, door closers, exit devices, overhead stops, and electromechanical door hardware.

B. Meeting attendees shall be notified 7 days in advance and shall include: Architect, Contractor, Door Hardware Installers (including low voltage hardware), Manufacturers representatives for above hardware items, and any other effected subcontractors or suppliers.

C. All attendees shall be prepared to distribute installation manuals, hardware schedules, templates, and physical hardware samples.

1.9 WARRANTY

A. All hardware items shall be warranted against defects in material and workmanship as set forth in Division One General Requirements.

B. Repair, replace, or otherwise correct deficient materials and workmanship without additional cost to owner.

PART 2 - PRODUCTS

2.1 FASTENERS

A. All exposed fasteners shall be Phillips head or as otherwise specified, and shall match the finish of the adjacent hardware. All fasteners ex-posed to the weather shall be non-ferrous or stainless steel. Furnish correct fasteners to accommodate surrounding conditions.

B. Coordinate required reinforcements for doors and frames. Seek approval of the architect prior to furnishing through-bolts. Furnish through-bolts as required for materials not readily reinforced.

2.2 BUTT HINGES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Stanley	Hager	McKinney
1. Standard Weight, Plain Bearing	5PB1	F179	1279	T2714
2. Standard Weight, Ball Bearing	5BB1	BB179	BB1279	TB2714
3. Standard Weight, Ball Bearing, Non-Ferrous	5BB1	FBB191	BB1191	TB2314
4. Heavy Weight, Ball Bearing	5BB1HW	FBB168	BB1168	T4B3786
5. Heavy Weight, Ball Bearing, Non-Ferrous	5BB1HW	FBB199	BB1199	T4B3386

B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.1 (2006). Hinges shall meet or exceed the following ANSI grade requirements as indicated below:

1. Standard Weight, Plain Bearing Hinges: Grade 3
2. Standard Weight, 2 Ball Bearing Hinges: Grade 2
3. Heavy Weight, 4 Ball Bearing Hinges: Grade 1

C. Unless otherwise specified, furnish the following hinge quantities for each door leaf.

1. 3 hinges for doors up to 90 inches.
2. 1 additional hinge for every 30 inch on doors over 90 inches.
3. 4 hinges for Dutch door applications.

D. Unless otherwise specified, top and bottom hinges shall be located as specified in division 8 Section "Hollow Metal Doors and Frames". Intermediate hinges shall be located equidistant from others.

E. Unless otherwise specified, furnish hinge weight and type as follows:

1. Standard weight: plain bearing hinge 5PB1 for interior openings through 36 inches wide without a door closer.
2. Standard weight: ball bearing hinge 5BB1 for interior opening over 36 through 40 inches wide without a door closer, and for interior openings through 40 inches wide with a door closer.
3. Heavyweight: 4 ball bearing hinge 5BB1HW for interior openings over 40 inches wide, and for all vestibule doors.
4. Heavyweight: 4 ball bearing hinge 5BB1HWss for exterior openings unless otherwise listed in groups.

F. Unless otherwise specified, furnish hinges for exterior doors, fabricated from brass, bronze, or stainless steel. Unless otherwise specified, hinges for interior doors may be fabricated from steel.

G. Unless otherwise specified, furnish hinges in the following sizes:

1. 5" x 5" 2-1/4" thick doors
2. 4-1/2" x 4-1/2" 1-3/4" thick doors
3. 3-1/2" x 3-1/2" 1-3/8" thick doors

H. Furnish hinges with sufficient width to accommodate trim and allow for 180-degree swing.

I. Unless otherwise specified, furnish hinges with flat button tips with non-rising pins at interior doors, non-removable loose pins (NRP) at exterior, and out-swinging lockable interior doors.

J. Unless otherwise specified, furnish all hinges to template standards.

2.3 CONTINUOUS PIN AND BARREL HINGES

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Marker	Stanley	McKinney
1. Edge Mount Pin & Barrel Stainless Steel Continuous Hinge	700 Series	300 Series	650 Series	300 Series

B. Hinges shall be independently certified by ANSI for compliance with ANSI A156.26, Grade 1 (2012).

C. Continuous hinges shall be full height pin and barrel type hinge providing full height door support up to 600 lbs. Edge mount (unless noted otherwise).

D. Construct hinges of heavy-duty 14-gauge material. The stainless internal pin shall have a diameter of 0.25 and the exterior barrel diameter of 0.438.

E. Hinge shall be non-handed with symmetrical template hole pattern and factory drilled. Hinge must accept a minimum of 21 fasteners on the door and 21 fasteners on the frame.

F. Each knuckle to be 2 inch, including split nylon bearing at each separation for quiet, smooth, self-lubricating operation.

G. Hinge to be able to carry Warnock Hersey Int. or UL for fire rated doors and frames up to 3 hours.

H. Provide machine screws for doors which have been reinforced to accept machine screws.

I. Note: Fire label for doors and frames should be placed on the header and top rail of fire rated doors and frames.

J. Provide adjusting screws equal to Ives “Adjust-a-Stud” for continuous hinges specified as 705. Adjustment to be able to correct frame fit problems up to 3/8 inch.

2.4 LOCKS AND LATCHES

A. Acceptable manufacturers and respective catalog numbers:

	Schlage	Best	Sargent
1. Grade 1 Mortise	L Series 17A	45H Series 14H	8200 LNP

A. Mortise locks shall be independently certified by ANSI for compliance with ANSI A156.13 (2012).

B. Unless otherwise specified, all locks and latches to have:

1. 2-3/4" Backset
2. 1/2" minimum throw latchbolt
3. 1" throw deadbolt
4. cylinders
5. ANSI A115.2 strikes

C. Provide guarded latch bolts for all locksets, and latch bolts with sufficient throw to maintain fire rating of both single and paired door assemblies.

D. Length of strike lip shall be sufficient to clear surrounding trim.

E. Provide wrought boxes for strikes at inactive doors, wood frames, and metal frames without integral mortar covers.

2.5 PULLS, PUSH BARS, PUSH/PULL PLATES

A. Acceptable manufacturers and respective catalog numbers:

		Burns	Hager	Ives
1.	Straight Pull (1" dia., 10" ctc)	26C	4J	8103-0
2.	Straight Pull (3/4” dia., 8” ctc)	25B	3G	8102-8
3.	Offset Door Pull (1" dia., 10" ctc)	39C	12J	8190-0
4.	Pull / Push-Bar (1" dia., 10" ctc Pull)	422 x 26C	153	9103-0
5.	Offset Pull / Push-Bar (1" dia., 10" ctc Pull)	422 x 39C	159	9190-0
6.	Push Plate (.050 4"X 16")	54	30S 4 x 16	8200 4 x 16
7.	Push Plate (.050 6"X 16")	56	30S 6 x 16	8200 6" X 16"
8.	Pull Plate (1" dia., 10" ctc - .050" X 4" X 16")	5426C	34J 4 x 16	8303-0 4" X 16"
9.	Ladder Pull (1” dia., flat tip)	VP4241	915	9266F
10.	Flush Pull	459C	16N	960

A. Adjust dimensions of push plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, push plates shall be factory drilled for cylinders or other mortised hardware. All push plates shall be beveled 4 sides and counter sunk.

B. Where possible, provide back-to-back, and concealed mounting for pulls and push bars. Push bar length shall be 3" less door width, or center of stile to center of stile for stile & rail or full glass doors.

2.6 CLOSERS

A. Acceptable manufacturers and respective catalog numbers:

	LCN	No Substitution
1.	4011 /4111 EDA	

B. Door closers shall be independently certified by ANSI for compliance with ANSI A156.4, Grade 1 (2013).

C. Obtain door closers from a single manufacturer, although several may be indicated as offering products complying with requirements.

D. Provide extra heavy duty arm (EDA / HD) when closer is to be installed using parallel arm mounting.

E. Hardware supplier shall coordinate with related trades to insure aluminum frame profiles will accommodate specified door closers.

F. Closers shall use high strength cast iron cylinders, forged main arms, and 1 piece forged steel pistons.

G. Closers shall utilize a stable fluid withstanding temperature range of +120deg F to -30deg F without seasonal adjustment of closer speed to properly close the door. Closers for fire-rated doors shall be provided with temperature stabilizing fluid that complies with standards UL10C.

H. Unless otherwise specified, all door closers shall have full covers and separate adjusting valves for sweeps, latch, and backcheck.

I. Provide closers for all labeled doors. Provide closer series and type consistent with other closers for similar doors specified elsewhere on the project.

J. Provide closers with adjustable spring power. Size closers to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Size all other door closers to allow for reduced opening force not to exceed 5 lbs.

K. Install closers on the room side of corridor doors, stair side of stairways and interior side of exterior doors.

L. Closers shall be furnished complete with all mounting brackets and cover plates as required by door and frame conditions, and by adjacent hardware.

M. Door closers shall be provided with a powder coat finish to provide superior protection against the effects of weathering. Powder coat finish shall successfully pass a 100 hour salt spray test.

N. Pressure Relief Valve, PRV, shall not be acceptable.

2.7 KICK PLATES AND MOP PLATES

A. Furnish protective plates as specified in hardware groups.

B. Where specified, provide 10" kick plates, 34" armor plates, and 4" mop plates. Unless otherwise specified, metal protective plates shall be .050" thick; plastic plates shall be 1/8" thick.

C. Protective plates shall be 2" less door width, or 1" less door width at pairs. All protective plates shall be beveled 4 sides and counter sunk.

D. Protection plates over 16" shall not be provided for labeled doors unless specifically approved by door manufacturers listing. When protection plates over 16” are provided for labeled doors, the plate shall be labeled.

E. Where specified, provide surface mounted door edges. Edges shall butt to protective plates. Provide edges with cutouts as required adjacent hardware.

F. Adjust dimensions of protection plates to accommodate stile and rail dimensions, lite and louver cutouts, and adjacent hardware. Where required by adjacent hardware, protection plates shall be factory drilled for cylinders or other mortised hardware.

2.8 OVERHEAD STOPS

A. Acceptable manufacturers and respective catalog numbers:

	Glynn-Johnson	Rixson	Sargent
1. Heavy Duty Surface Mount	GJ900 Series	9 Series	590
2. Heavy Duty Concealed Mount	GJ100 Series	1 Series	690
3. Medium Duty Surface Mount	GJ450 Series	10 Series	1540
4. Medium Duty Concealed Mount	GJ410	2 Series	1530

B. Unless otherwise specified, furnish GJ900 series overhead stop for hollow metal or 1-3/4” solid core doors equipped with regular arm surface type closers that swing more than 140 degrees before striking a wall, for hollow metal or 1-3/4” solid core doors that open against equipment, casework, sidelights, or other objects that would make wall bumpers inappropriate, and as specified in hardware groups.

C. Furnish sex bolt attachments for wood and mineral core doors unless doors are supplied with proper reinforcing blocks.

D. Provide special stop only (“SE” suffix) overhead stops when used in conjunction with electronic hold open closers.

E. Do not provide holder function for labeled doors.

2.9 WALL STOPS AND HOLDERS

A. Acceptable manufacturers and respective catalog numbers:

	Ives	Hager	Burns
1. Wrought Convex Wall Stop	WS406CVX	232W	570
2. Wrought Concave Wall Stop	WS406CCV	236W	575

B. Furnish a stop or holder for all doors. Furnish floor stops or hinge pin stops only where specifically specified.

C. Provide Concave Wall Stop at locksets with push button options only.

D. Where wall stops are not applicable, furnish overhead stops.

E. Do not provide holder function for labeled doors.

2.10 WEATHERSTRIP, GASKETING

A. Acceptable manufacturers and respective catalog numbers:

		Zero	Pemko	NGP	Reese
1.	Weatherstrip	429	2891_PK	700NA	755
2.	Adhesive Gasket	188	S88	5050	797
3.	Mullion Seal/Silencer	8780	5110	5100N	
4.	Adhesive Edge Seal	188S	S771	5060	****
5.	Automatic Door Bottom (HD Concealed) (When Sealing Against A Solid Surface)	360	434_RL	423N	430
6.	Automatic Door Bottom (HD Concealed) (When Sealing Against Carpet)	360	434_NBL	683	943
7.	Sweeps	8192	18061_NB	B606	964
8.	Sweep w/ drip	8198	345_N	C627	354
9.	Drip Cap	142	346	16	R201

B. Weatherstrip and gasketing shall be independently certified by ANSI for compliance with ANSI A156.22 (2005).

C. Where specified in the hardware groups, furnish the above products unless otherwise detailed in groups.

D. Provide weatherstripping all exterior doors and where specified.

E. Provide intumescent and other required edge sealing systems as required by individual fire door listings to comply with positive pressure standards UL 10C.

F. Provide Zero 188 smoke gaskets at all fire rated doors and smoke and draft control assemblies.

G. Provide gasketing for all meeting edges on pairs of fire doors. Gasketing shall be compatible with astragal design provided by door supplier as required for specific fire door listings.

2.11 THRESHOLDS

A. Acceptable manufacturers and respective catalog numbers:

		Zero	Pemko	NGP	Reese
1.	Saddle Thresholds	8655	171	425	S205

A. Thresholds shall be independently certified by ANSI for compliance with ANSI A156.21 (2001).

B. Hardware supplier shall verify all finish floor conditions and coordinate proper threshold as required to insure a smooth transition between threshold and interior floor finish.

C. Threshold Types:

1. Unless otherwise specified, provide saddle threshold similar to Zero 8655 for all exterior openings with an interior floor finish less than or equal to 1/4" in height.
2. Unless otherwise specified, provide half saddle threshold similar to Zero 1674 for all exterior openings with an interior floor finish greater than 1/4" in height. Threshold height shall match thickness of interior floor finish.

2.12 ELECTRIC STRIKES

A. Acceptable manufacturers and respective catalog numbers:

		Von Duprin	Folger Adams
1.	Type 1	6000 Series	300 Series

B. Provide electric strikes designed for use with the type of locks shown at each opening where specified.

C. Electric strikes shall be UL listed as Burglary-Resistant Electric Door Strikes and where required shall be UL listed as Electric Strike for Fire Doors.

D. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.13 POWER SUPPLIES

A. Provide quantities and types as specified in hardware sets. Shared power supplies will not be accepted without prior approval from the owner.

B. All power supplies shall have the following features:

1. 12/24 VDC Output, field selectable.
2. Class 2 Rated power limited output.
3. Universal 120-240 VAC input.
4. Low voltage DC, regulated and filtered.
5. Polarized connector for distribution boards.
6. Fused primary input.
7. AC input and DC output monitoring circuit w/LED indicators.
8. Cover mounted AC Input indication.
9. Tested and certified to meet UL294.
10. NEMA 1 enclosure.
11. Hinged cover w/lock down screws.
12. High voltage protective cover.

C. All power supplies shall incorporate fused distribution boards.

D. All electro-mechanical systems requiring fail safe circuits shall be capable of interfacing with the fire alarm system to cut power to appropriate system components. Unless already provided in another system component, all power supplies utilized in fail safe circuits shall include an integral relay which when connected to the N/C fire alarm contact will cut power to all openings connected to the individual power supply. Power supply, unless otherwise specified, will automatically reset itself when fire alarm relay returns to normal state following a fire alarm.

2.14 FINISHES AND BASE MATERIALS

A. Unless otherwise indicated in the hardware groups or herein, hardware finishes shall be applied over base metals as specified in the following finish schedule:

	HARDWARE ITEM	BHMA FINISH AND BASE MATERIAL
1.	Butt Hinges: Exterior, or Non-Ferrous	630 (US32D - Satin Stainless Steel)
2.	Butt Hinges: Interior	652 (US26D - Satin Chromium)
3.	Continuous Hinges	630 (US32D - Satin Stainless Steel)
4.	Exit Devices	626 (US26D - Satin Chromium)
5.	Locks and Latches	626 (US26D - Satin Chromium)
6.	Pulls and Push Plates/Bars	630 (US32D - Satin Stainless Steel)
7.	Closers	689 (Powder Coat Aluminum)
8.	Protective Plates	630 (US32D - Satin Stainless Steel)
9.	Overhead Stops	630 (US32D - Satin Stainless Steel)
10.	Wall Stops and Holders	630 (US32D - Satin Stainless Steel)
11.	Thresholds	628 (Mill Aluminum)
12.	Weather-strip, Sweeps Drip Caps	Aluminum Anodized
13.	Miscellaneous	626 (US26D - Satin Chromium)

2.15 KEYING

A. Acceptable manufacturers and respective catalog numbers:

1. Medeco No Substitution

B. All locks and cylinders shall accommodate Medeco interchangeable cores.

C. Cores and keys shall be provided by owner.

D. The owner shall install the cores. At the contractor's request, the owner shall install a limited number of temporary cores during construction with the appropriate cost charged to the contractor.

E. The contractor must request all owner keys 24 hours in advance of using them. The contractor will be charged for any keys that are not returned to the owner when the project is completed. The charge will be equal to the cost of replacing any locks and keys relevant to the key code for those locks and keys.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Prior to installation of hardware, installer shall examine door frame installation to insure frames have been set square and plumb. Installer shall examine doors, door frames, and adjacent wall, floor, and ceiling for conditions, which would adversely affect proper operation and function of door assemblies. Do not proceed with hardware installation until such deficiencies have been corrected.

3.2 INSTALLATION

A. Before hardware installation, general contractor/construction manager shall coordinate a hardware installation seminar with a 1 week notice to all parties involved. The seminar is to be conducted on the installation of hardware, specifically of locksets, closers, exit devices, continuous hinges and overhead stops. Manufacturer's representative of the above products to present seminar. Seminar to be held at the job site and attended by installers of hardware (including low voltage hardware) for aluminum, hollow metal and wood doors. Training to include use of installation manuals, hardware schedule, templates and physical products samples.

B. Install all hardware in accordance with the approved hardware schedule and manufacturers instructions for installation and adjustment.

C. Set units level, plumb and true to the line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

D. Drill and countersink units which are not factory-prepared for anchorage fasteners. Space fasteners and anchors in accord with industry standards.

E. Drill appropriate size pilot holes for all hardware attached to wood doors and frames.

F. Shim doors as required to maintain proper operating clearance between door and frame.

G. Unless otherwise specified, locate all hardware in accordance with the recommended locations for builders hardware for standard doors and frames as published by the Door and Hardware Institute.

H. Use only fasteners supplied by or approved by the manufacturer for each respective item of hardware.

I. Mortise and cut to close tolerance and conceal evidence of cutting in the finished work.

J. Conceal push and pull bar fasteners where possible. Do not install through bolts through push plates.

K. Install hardware on UL labeled openings in accordance with manufacturer's requirements to maintain the label.

L. Apply self-adhesive gasketing on frame stop at head & latch side and on rabbet of frame at hinge side.

M. Install hardware in accordance with supplemental "S" label instructions on all fire rated openings.

N. Install wall stops to contact lever handles or pulls. Do not mount wall stops on casework, or equipment.

O. Where necessary, adjust doors and hardware as required to eliminate binding between strike and latchbolt. Doors should not rattle.

P. Overhead stops used in conjunction with electrified hold open closers shall be templated and installed to coincide with engagement of closer hold open position.

Q. Install door closers on corridor side of lobby doors, room side of corridor doors, and stair side of stairways.

R. Adjust spring power of door closers to the minimum force required to insure exterior and fire rated doors will consistently close and latch doors under existing conditions. Adjust all other door closers to insure opening force does not to exceed 5 lbs.

S. Adjust "sweep", "latch", & "back check" valves on all door closers to properly control door throughout the opening and closing cycle. Adjust total closing speed as required to comply with all applicable state and local building codes.

T. Install "hardware compatible" (bar stock) type weatherstripping continuously for an uninterrupted seal. Adjust templating for parallel arm door closers, exit devices, etc., as required to accommodate weatherstripping.

U. Unless otherwise specified or detailed, install thresholds with the bevel in vertical alignment with the outside door face. Notch and closely fit thresholds to frame profile. Set thresholds in full bed of sealant.

V. Compress sweep during installation as recommended by sweep manufacturer to facilitate a water resistant seal.

W. Deliver to the owner 1 complete set of installation and adjustment instructions, and tools as furnished with the hardware.

3.3 FIELD QUALITY CONTROL

A. After installation has been completed, the hardware supplier and manufacturers representative for locksets, door closers, exit devices, and overhead stops shall check the project and verify compliance with installation instructions, adjustment of all hardware items, and proper application according to the approved hardware schedule. Hardware supplier shall submit a list of all hardware that has not been installed correctly.

B. After installation has been completed, the hardware supplier and manufacturers representative shall meet with the owner to explain the functions, uses, adjustment, and maintenance of each item of hardware. Hardware supplier shall provide the owner with a copy of all wiring diagrams. Wiring diagrams shall be opening specific and include both a riser diagram and point to point diagram showing all wiring terminations.

3.4 ADJUSTMENT AND CLEANING

A. At final completion, and when H.V.A.C. equipment is in operation, installer shall make final adjustments to and verify proper operation of all door closers and other items of hardware. . Lubricate moving parts with type lubrication recommended by the manufacturer.

B. All hardware shall be left clean and in good operation. Hardware found to be disfigured, defective, or inoperative shall be repaired or replaced.

3.5 HARDWARE SCHEDULE

A. The following schedule of hardware groups are intended to describe opening function. The hardware supplier is cautioned to refer to the preamble of this specification for a complete description of all materials and services to be furnished under this section.

HWSET #: 01

QTY	DESCRIPTION	CATALOG NUMBER	MFR
EA	ALL HARDWARE BY	DOOR SUPPLIER	B/O

HWSET #: 02

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	OH STOP	90S	GLY

FUNCTION: L9010 (F01) PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HWSET #: 03

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	CLASSROOM LOCK	L9070	SCH
1	EA	PERMANANT CORE	BY OWNER	MED
1	EA	OH STOP	90S	GLY

FUNCTION: L9070 (F05) CLASSROOM LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY KEY. UNLOCKED FROM OUTSIDE BY KEY. INSIDE LEVER ALWAYS FREE FOR IMMEDIATE EXIT. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HWSET #: 04

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	PERMANANT CORE	BY OWNER	MED
1	EA	OH STOP	90S	GLY

FUNCTION: L9080 (F07) STOREROOM LOCK
LATCHBOLT RETRACTED BY KEY OUTSIDE OR BY LEVER INSIDE. OUTSIDE LEVER ALWAYS INOPERATIVE. AUXILIARY LATCH DEADLOCKS LATCHBOLT WHEN DOOR IS CLOSED.

HWSET #: 05

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	188S	ZER

FUNCTION: L9010 (F01) PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HWSET #: 06

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PASSAGE SET	L9010	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	GASKETING	188S (2 ROWS: (1) STOP MTD, (1) RABBET MTD)	ZER
1	EA	DOOR BOTTOM	360	ZER

FUNCTION: L9010 (F01) PASSAGE LATCH
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE AT ALL TIMES.

HWSET #: 07

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	PRIVACY LOCK	L9040 L583-363 L283-722	SCH
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4011 H	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE

FUNCTION: L9040 (F22) BATH/BEDROOM PRIVACY LOCK
LATCHBOLT RETRACTED BY LEVER FROM EITHER SIDE UNLESS OUTSIDE IS LOCKED BY INSIDE THUMBTURN. TURNING INSIDE LEVER OR CLOSING DOOR UNLOCKS OUTSIDE LEVER. TO UNLOCK FROM OUTSIDE, REMOVE EMERGENCY BUTTON, INSERT EMERGENCY TURN (FURNISHED) IN ACCESS HOLE AND ROTATE. OUTSIDE INDICATOR DISPLAYS "OCCUPIED" OR "VACANT" PLATE.

HWSET #: 08

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	700	IVE
1	EA	DOOR PULL, 1" ROUND	8103 10"	IVE
1	EA	PUSH BAR	9100	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4011 H	LCN

PUSH/PULL

HWSET #: 09

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	PERMANANT CORE	BY OWNER	MED
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	OH STOP	90S	GLY
1	EA	SURFACE CLOSER	4011/4111 EDA	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	POWER SUPPLY	PS902 900-4R	SCE
1	EA	ELEVATION DRAWING		
1	EA	WIRE DIAGRAM	POINT TO POINT	

FUNCTION: PRESENTATION OF VALID CREDENTIAL MOMENTARILY UNLOCKS DOOR.

HWSET #: 10

QTY		DESCRIPTION	CATALOG NUMBER	MFR
	EA	HINGE	AS REQUIRED	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	PERMANANT CORE	BY OWNER	MED
1	EA	ELECTRIC STRIKE	6211 FSE	VON
1	EA	LOCK GUARD	LG	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	IVE
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTIP	429	ZER
1	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	8655	ZER
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	PS902 900-4R	SCE
1	EA	WIRE DIAGRAM	POINT TO POINT	
1	EA	ELEVATION DRAWING		

FUNCTION: PRESENTATION OF VALID CREDENTIAL MOMENTARILY UNLOCKS DOOR.

HWSET #: 11

QTY		DESCRIPTION	CATALOG NUMBER	MFR
1	EA	CONT. HINGE	700	IVE
1	EA	STOREROOM LOCK	L9080	SCH
1	EA	PERMANANT CORE	BY OWNER	MED
1	EA	ELECTRIC STRIKE	6211AL FSE	VON
1	EA	LOCK GUARD	LG	IVE
1	EA	OH STOP	100S	GLY
1	EA	SURFACE CLOSER	4111 HEDA	LCN
1	EA	RAIN DRIP	142	ZER
1	EA	WEATHERSTRIP	BY DR/FR SUPPLIER	B/O
1	EA	DOOR SWEEP	8198	ZER
1	EA	THRESHOLD	8655	ZER
1	EA	CARD READER	BY SECURITY SUPPLIER	
1	EA	DOOR CONTACT	679-05	SCE
1	EA	POWER SUPPLY	PS902 900-4R	SCE
1	EA	WIRE DIAGRAM	POINT TO POINT	
1	EA	ELEVATION DRAWING		

FUNCTION: PRESENTATION OF VALID CREDENTIAL MOMENTARILY UNLOCKS DOOR.

DOOR HARDWARE INDEX

Door Numbers	HwSet#
100A	01
100B	01
100C	10
101A	01
101B	05
102	01
103	03
104	11
104A	08
107	02
109	09
110	05
112A	02
112B	02
112C	11
113	07
114	07
115	04
202	06

END OF SECTION 08 71 00

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SECTION 08 80 00 - GLAZING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Hollow Metal Doors and Frames.
2. Aluminum Framing and entrances.

1.3 PERFORMANCE REQUIREMENTS

A. Design glass, according to ASTM E 1300 using the following design criteria:

1. Design Wind Pressures: As required by code.
2. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.
3. Thermal Stresses: Design glass to resist thermal stresses induced by differential shading, and normal thermal movement within individual glass lites.

1.4 ACTION SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product and sealant or gasket color, other than clear monolithic vision glass; approx. 6” square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Certificate or label: Submit manufacturer-certified compliance with requirements or label representing a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authorities having jurisdiction.

1.5 INFORMATIONAL SUBMITTALS

A. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA's "Laminated Glazing Reference Manual" and GANA's "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Single source responsibility for glass: Provide materials produced by a single manufacturer or fabricator for each kind and condition of glass.

E. Provide glass from a manufacturer that is known and respected for quality control and longevity of product.

1.7 WARRANTY

A. Manufacturer's Special Warranty for Low-E Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to furnish and install coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which laminated-glass manufacturer agrees to furnish and install laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which insulating-glass manufacturer agrees to furnish and install insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to

manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTUERS

A. Provide standard clear uninsulated glass units from any reputable glass house including Brin Northwestern Glass.

B. Provide insulated glass units from one of the following:

1. Old Castle Glass
2. Viracon Glass
3. Approved equal

2.2 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as required to comply with requirements indicated and in no case less than 1/4” thickness.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
1. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article.
2. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 expressed as Btu/sq. ft. x h x deg F.
2. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

D. Refer to item 2.9 for glass types.

2.3 GLASS PRODUCTS

A. **Laminated Glass**: Shall be provided at **all locations required by code**. Shall comply with ASTM 1172 Standard Spec for laminated float glass. All laminated glass shall conform to ANSI Z97.1 and CPSC 16 CFR 1201.Laminated glass products to be fabricated free of foreign substances and air or glass pockets in autoclave with heat and pressure. Provide laminated glass at all locations that require safety glazing adjacent to grade/floor, above entrances, within entrance doors, adjacent to entrances and as otherwise required by code.

B. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

2.4 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.

1. Sealing System: Dual seal.
2. Spacer: Manufacturer's standard spacer material and construction.

2.5 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, as recommended by the glass manufacturer.

B. Gaskets in paragraph below are for use between glass and frame (or fixed stop) where they will be compressed by inserting dense compression gaskets or by pressure-glazing stops. Neoprene is not compatible with silicone glazing sealants.

C. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned neoprene, EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.6 GLAZING SEALANTS

A. General:

1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Sealants used inside the weatherproofing system, shall have a VOC content of not more than 250 g/L when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, UseNT. Provide Class 100/50/25 as required for application.

2.7 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; non-staining and non-migrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.8 MISCELLANEOUS GLAZING AND NON-GLAZING MATERIALS

A. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

B. Setting Blocks: Elastomeric material with a Shore, Type Adurometer hardness of 85, plus or minus 5.

C. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

D. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

E. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 GLASS TYPES

A. The following glass types are indicated for bidding purposes. Once samples are requested and furnished, a glass tine/color will be verified and provided. Although proprietary models may be indicated, manufacturers should provide glass types which are the same using their model numbers.

B. Glass Type Interior: Clear (tempered as required by code) float glass. Thickness: ¼”

C. Glass type Exterior clear: High performance insulated Low E tinted glass: VE1-2M.

D. All glass shall be tempered as required to meet code, with locations near grade, next to entranceways and as otherwise recommended by the manufacturer.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Clean glazing channels and other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to substrates. Remove lacquer from metal surfaces where elastomeric sealants are indicated for use.

C. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

D. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

E. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

F. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

G. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

H. Provide spacers for glass lites where length plus width is larger than 50 united inches.

I. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying

pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.4 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

END OF SECTION 08 80 00

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SECTION 09 29 00 - GYPSUM BOARD

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Tile backing panels.
3. Joint taping and sanding.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:

1. CertainTeed Corp.
2. Georgia-Pacific Gypsum LLC.
3. National Gypsum Company.
4. USG Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.3 PRODUCTS GENERAL

A. All materials furnished or installed under this Section shall be provided by one manufacturer or as recommended by separate manufacturers for use together installed according to their requirements.

2.4 INTERIOR GYPSUM BOARD

A. Gypsum Board, Type X: ASTM C 1396.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

B. Gypsum Ceiling Board, Type X: ASTM C 1396.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges. **This product is to be used at the shower walls and ceilings.**

1. Products: Subject to compliance with requirements, provide one of the following:
   a. C-Cure.
   b. CertainTeed Corp.
   c. Custom Building Products.
   d. James Hardie Building Products, Inc.
   e. National Gypsum Company.
   f. USG Corporation.

2. Thickness: **5/8 inch**.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc Paper-faced galvanized steel sheet.

B. Exterior Trim: ASTM C 1047.

1. Material: Hot-dip galvanized steel sheet or rolled zinc.

C. Aluminum Trim: ASTM B 221, Alloy 6063-T5.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

2.8 AUXILIARY MATERIALS

A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.

B. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing).

C. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

D. Vapor Retarder: As specified in Section 072100 "Thermal Insulation."

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS - GENERAL

A. Comply with ASTM C 840.

B. Install gypsum board in accordance with the manufacturer's and U.L. requirements to achieve required design rating at ceilings, walls, columns and beams.

C. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

D. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

E. Install trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

1. Aluminum Trim: Install in locations indicated on Drawings.
2. Control Joints: Install control joints at locations indicated on Drawings ASTM C 840 and as required by.
3. Place corner beads at external corners. Use longest practical lengths. Place edge trim where gypsum board abuts dissimilar materials, or as indicated on the drawings.

F. Prefill open joints and damaged surface areas.

G. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

H. Provide 5/8” Type X at interior locations unless otherwise indicated.

I. Provide Water resistant backing board at all restroom walls and ceilings as applicable.

J. Provide cement board tile backer at wet locations that have tile such as shower walls. Treat edges, seams, terminations and corners as recommended by manufacturer.

3.2 GYPSUM BOARD INSTALLATION

A. Install gypsum board in accordance with the manufacturer's and U.L. requirements to achieve required design rating at ceilings, walls, columns and beams.

B. Provide expansion joints such as USG 093 in long walls 30'-0" on center, above each corridor door jamb on corridor side. Provide expansion joints including slip joints at head of walls if required to prevent wall cracking elsewhere in conformance with manufacturer's instructions.

3.3 SINGLE LAYER APPLICATION TO STUDS

A. For single layer application apply gypsum boards with long dimension perpendicular to framing. Use maximum practical lengths to minimize end joints. Position boards so all abutting ends and edges (except edges with perpendicular application) will be located in center of stud flanges. Joints shall be neatly fitted and staggered on opposite sides of partition.

B. At wood stud walls, install all gypsum board using screws in accordance with manufacturer's recommendations.

3.4 GYPSUM BOARD FINISH LEVELS

A. See "Gypsum Board Finish Levels" Article in the Evaluations for a discussion of requirements of various levels.

B. Tape and fill all joints and screw holes as recommended by manufacturer, using sufficient number of coats to fill all depressions leaving the surface smooth and free of blemishes. Keep sanding to a minimum. Finish of drywall after taping and sanding shall be level with adjoining wallboard and be suitable to receive finishes specified in other sections of the specification. Excessive sanding and raised nap on wallboard will not be accepted.

C. Finish panels to levels indicated below and according to ASTM C 840:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
2. Level 2: Panels that are substrate for tile.
3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.

    a. Primer and its application to surfaces are specified in Section 099123 "Painting."

3.5 PROTECTION

1. Protect adjacent surfaces from drywall compound and texture finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
2. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 09 29 00

SECTION 09 30 00 - TILING

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.
   1. Performance of the Work of this Section shall comply with Division 00 Prevailing Wage Rate Requirements that apply to this project.

1.2 SUMMARY

A. Section Includes:

   1. Porcelain Tile.
   2. Anodized aluminum cove base and wainscot caps.
   3. Solid surface thresholds

B. CAUTIONARY NOTE: Some tile specified herein may not be stocked domestically and could have lead times to acquire. Contractor is responsible for ordering tile in a timely manner to have installation occur on time. Any additional shipping or acquisition charges resulting from not ordering tile in a timely manner will be the responsibility of the contractor. Substitution of tile because of the contractor not ordering in time is not allowed.

1.3 RELATED WORK

A. 09 29 00- Gypsum Wallboard (for Tile Backing board)
B. 03 30 00- Concrete
C. 04 22 00- Unit Masonry
D. 07 92 00- Joint Sealants

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples:

   1. Each type and composition of tile for selection by Architect for each color and finish required.
   2. Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials from the same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-sized units equal to 5 percent of the amount installed for each type, composition, color, pattern, and size indicated.

1.6 QUALITY ASSURANCE

A. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout and setting materials.

B. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Prevent damage or contamination to materials by water, freezing, foreign matter or other causes.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Tile: Refer to Tile Products for specific manufacturers and series of tile and related items for use on this project.

B. Accessories and Transitions- Subject to compliance with requirements, provide products by one of the following:

1. Schluter Systems
2. PROVA Products

2.2 MATERIALS

A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. Refer to drawings, plans, and finish schedules for locations of tile.

1. Ceramic Wall Tile #1

    1. Manufacturers: Subject to compliance with requirements, provide products represented by the following:

        a. Ceramic Tileworks

    2. Composition: Glazed Ceramic Wall Tile
    3. Line: Builder Basic
    4. Color: White Ice
    5. Module Size: 4” x 10”
    6. Thickness: 7.5mm
    7. Face: Plain
    8. Finish: Gloss
    9. Install Pattern: 1/2 running bond pattern
    10. Grout Colors: As selected by Architect
    11. Trim Units and accessories: See bulleted item #3 on the next page.

2. Porcelain Floor Tile

    1. Manufacturers: Subject to compliance with requirements, provide products represented by the following:

        a. Iris U.S.

    2. Composition: Porcelain
    3. Line: Ecocrete
    4. Color: Sage

5. Thickness: 5/16”
6. Module Size: 12” x 24”
7. Coefficient of Friction: Not less than 0.42
8. Finish/Face: Honed
9. Install Pattern: 1/2 running bond
10. Grout Colors: As selected by Architect
11. Grout Joint: 3/32”

3. Transition accessories including cove pieces, wainscot cap trim units, and edge protection pieces:

    1. Products utilized- product numbers based on Schluter Systems:
        a. DILEX-AHK: Satin anodized aluminum cove-shaped profile for floor/wall transitions.
        b. QUADEC: Satin anodized aluminum vertical edge protection profile for tiled outside corners.
        c. QUADEC-K: Satin anodized aluminum horizontal wainscot cap for tiled walls
        d. RENO-RAMP: Satin anodized aluminum transition between tile and finished concrete.

    2. Provide all in and out corners, connectors, and floor transitions as required to complete the system and provide a clean and finished look.

2.3 WATERPROOF MEMBRANE

A. General: Manufacturer's standard product, selected from the following that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated.

B. Waterproof membrane as recommended for application in shower area floor and walls only, appropriate for substrate and tile to be used, from one of the following methods:

C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.

    1. Products: Subject to compliance with requirements, provide one of the following:

        a. Boiardi Products, a QEP company; Elastiment 344 Reinforced Waterproofing and Anti-Fracture/Crack Suppression Membrane.
        b. ProSpec (formerly Bonsal American); B 6000 Waterproof Membrane with Glass Fabric.
        c. Bostik, Inc.; Hydroment Blacktop 90210, flexible waterproofing and anti-fracture membrane.
        d. Custom Building Products; Custom 9240 Waterproofing and Anti-Fracture Membrane.
        e. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
        f. MAPEI Corporation; Mapelastic L (PRP M19), Mapelastic HPG with MAPEI Fiberglass Mesh-flexible waterproofing and crack-isolation membrane.
        g. Mer-Krete Products, Parex USA, Inc.; Hydro-Guard 2000 heavy-duty elastomeric waterproof and crack-isolation membrane.
        h. Summitville Tiles, Inc.; S-9000 Waterproof and crack-isolation membrane.

2.4 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

B. Standard Dry-Set Portland Cement Mortar (Thinset): ANSI A118.1.

    1. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:

a. Amerimix- Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. C-Cure.
d. Custom Building Products.
e. Laticrete International, Inc.
f. MAPEI Corporation.
g. Summitville Tiles, Inc.
h. TEC; a subsidiary of H. B. Fuller Company.

2. For wall applications, provide non-sagging mortar.

C. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:
a. Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. C-Cure.
d. Custom Building Products.
e. Laticrete International, Inc.
f. MAPEI Corporation.
g. Summitville Tiles, Inc.
h. TEC; a subsidiary of H. B. Fuller Company.

2. Prepackaged, dry-mortar mix to which only water must be added.
3. For wall applications, provide non-sagging mortar.
4. Prepackaged, dry-mortar mix combined with a liquid-latex additive.

2.5 GROUT MATERIALS

A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:

a. Bonsal American; an Oldcastle company.
b. Bostik, Inc.
c. C-Cure.
d. Custom Building Products.
e. Laticrete International, Inc.
f. MAPEI Corporation.
g. Summitville Tiles, Inc.
h. TEC; a subsidiary of H. B. Fuller Company.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Grout Sealer: Manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Bonsal American, an Oldcastle company; Grout Sealer.
b. Bostik, Inc.; CeramaSeal C-Cure; Penetrating Sealer 978.
c. Custom Building Products; Surfaceguard.
d. MAPEI Corporation; KER.
e. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
f. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
g. TEC, a subsidiary of H. B. Fuller Company.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Vent temporary heaters to exterior to prevent damage to tile work from carbon dioxide build-up.

3. Maintain temperatures at not less than 50 deg F (10 deg C) in tiled areas during installation and for 7 days after completion, unless higher temperatures are required by referenced installation standard or manufacturer's instructions.

3.2 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar or with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. Where required, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: If required by the manufacturer to prevent grout from staining or adhering to exposed tile surfaces, precoat tile with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:

a. Tile floors in wet areas.
b. Tile floors composed of tiles 8 by 8 inches or larger.
c. Tile floors composed of rib-backed tiles.

General Installation Standards: Install tile in accordance with ANSI A108 Standards, appropriate TCA methods, and written instructions of the specified manufacturers.

a. Thin-set Wall Installations Showers: TCNA Method B422-11
b. Thin-set Wall Installations - Gyp: TCNA Method W243-11
c. Thin-set Wall Installations - CMU: TCNA Method W202I-11

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:

1. 1/8” at all tiles.

G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Grout ceramic tile per ANSI A108.10.

I. Begin initial wiping of grout from tile per manufacturer's instructions, paying special attention to latex modified materials.

J. Follow manufacturer’s recommendations and use caution in installing tile over control joints in the concrete.

K. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants." Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints, unless otherwise indicated.

L. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

M. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

3.4 CLEANING AND PROTECTION

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces of foreign matter.

B. Unglazed tile may be cleaned with acid solution only when permitted by tile and grout manufacturer's printed instructions, but no sooner than 14 days after installation. Protect metal surfaces, cast iron and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.

C. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.

D. Protection: When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage and wear.

E. Prohibit foot and wheel traffic from using tiled floors for at least 7 days after grouting is completed.

F. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 00

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SECTION 09 51 13 – ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes acoustical ceiling panels and exposed suspension systems for ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 ENVIRONMENTAL CONDITION

A. Acoustical Panel Ceiling materials shall not be delivered until the building is thoroughly dry, enclosed and heated to interior conditions which approximate the normal occupied conditions.

B. All concrete, ceramic tile setting or any other wet installation product shall be complete and dry before Acoustical Ceiling work is commenced. No such work shall be performed during or after the installation of acoustical materials.

C. Acoustical Ceiling material installation shall be coordinated with mechanical and electrical work to avoid damage to acoustical materials complete concealed work prior to installation of ceiling.

1.6 EXTRA STOCK

A. Provide additional 5% extra material for each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers, ceiling tile: Subject to compliance with requirements, provide products manufactured by the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Chicago Metallic Corporation.
   4. Tectum Inc.
   5. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Manufacturers, grid system: Subject to compliance with requirements, provide products by manufactured by the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Chicago Metallic Corporation.
   4. USG Interiors, Inc.; Subsidiary of USG Corporation.

2.2 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 450 or less.

2.3 ACOUSTICAL PANEL CEILINGS, GENERAL

A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Comply with ASTM E 1264.

D. Metal Suspension System Standard: Comply with ASTM C 635.

E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.4 ACOUSTICAL PANELS

A. Typical locations: Equal to Armstrong “Dune” tile with fine texture, 3/4" x 24" x 24", NRC of 0.50 in white, with tegular edges to fit with 9/16” suspension system.

B. Color: White.

C. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

2.5 METAL SUSPENSION SYSTEM

A. Grid suspension system: 9/16" exposed, white aluminum "T" type grid system, including all main runners, cross tees, wall moldings and accessories.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical panel ceilings to comply with ASTM C 636 and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders and comply with layout shown on reflected ceiling plans.

1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

C. Suspension systems shall be placed true to line accurately spaced and level, and securely anchored to the supporting building structure only, not from mechanical or electrical equipment, piping, ductwork, or other non-structural elements of the building.

D. Coordination with Light Fixtures:

1. All lighting fixtures shall be positively attached to the suspended ceiling system. The attachment device shall have a capacity of 100 percent of the lighting fixture weight acting in any direction.
2. When "intermediate" systems are used, 12-gauge hangers shall be attached to the grid members within 3 inches of each corner of each fixture. Tandem fixtures may utilize common wires.

END OF SECTION 09 51 13

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SECTION 09 65 13 - RESILIENT / RUBBER FLOORING BASE AND ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base, to be used at locations as indicated on finish schedule.
2. Resilient edge/transition strips
3. Moisture vapor reducer

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

PART 2 - PRODUCTS

2.1 ANUFACTURERS

A. Manufacturers of resilient base: Subject to compliance with requirements, provide products manufactured by one of the following:

1. Armstrong World Industries, Inc.
2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
3. Johnsonite; A Tarkett Company.
4. Mondo Rubber International, Inc.
5. Nora Systems, Inc.
6. Roppe Corporation, USA.
7. Approved equal.

A. ATERIALS

A. Resilient Base Product Standard: ASTM F 1861, Type TP (rubber, PVC.

1. Group: I (solid, homogeneous).
2. 4" height, 1/8" thickness
3. Location: Provide in all areas indicated on the schedule to receive resilient base. Refer to drawings.

B. Resilient Edge/Transition Strips, Reducers, and Adaptors- composed of a homogeneous composition of polyvinyl chloride (PVC), high quality additives, and colorants. Sizes/ reducing heights will vary and depend on the materials being transitioned to. Review the drawings carefully, the transitions will be called out.

C. Adhesives (Cements): Waterproof, stabilized type as recommended by rubber flooring or vinyl base manufacturer to suit material and substrate conditions.

D. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer. As a part of the bid, provide any special primer that is determined necessary for a permanent bond to the concrete subsurface regardless of fully cured conditions of the slab (ie. Slab relative humidity)

E. Leveling and Patching Compounds: Latex type as recommended by flooring manufacturer.

2.3 INSTALLATION MATERIALS

A. Adhesives: Waterproof, stabilized type as recommended by flooring manufacturer to suit material and substrate conditions. Contact bond adhesive, applied by either brush or roller.

1. Adhesives shall have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
B. Do not install resilient products until they are the same temperature as the space where they are to be installed. (A minimum of 48 hours of acclimation time for both products and adhesives.)

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.
B. Room temperature must be maintained between 65 degrees F and 85 degrees F during installation and a minimum temperature of 55 degrees F must be maintained afterwards. The ambient relative humidity should be between 40% and 60%.
C. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
D. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
E. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
F. Do not stretch resilient base during installation.
G. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
H. Preformed Corners: Install preformed corners before installing straight pieces.
I. Reducer moldings shall be rolled with a J-hand roller after installation to ensure proper bonding.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

END OF SECTION 09 65 13

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SECTION 09 90 00 – PAINTING AND COATING

PART 1 – GENERAL

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 DESCRIPTION OF WORK:

A. Section includes painting work as indicated on drawings and schedules, and as herein specified.

B. Work includes surface preparation, priming, coating, filling of voids and other surface treatment. Shop priming and pre-finished products are not a part of this section. Refer to the drawings for more detailed information on locations and scope of work. The following is an abbreviated list of items to be included as a part of the paint section:

1) Exterior steel: hollow metal doors/frames, and other steel items.
2) Exterior bollards.
3) Interior steel rails, stairs, columns, beams, joists and related, where noted on the drawings.
4) Exposed ceilings.
5) Epoxy paint at the walls and ceilings of the wash bay area.
6) Epoxy paint at the floor of the mechanical room on the mezzanine.
7) Selected mechanical items which are located in exposed conditions next to walls and ceilings.
8) Other items as noted.

C. The scope of work includes painting the ceilings. A dryfall paint may be used on the ceiling areas (deck, joists, beams, piping, etc.)

1.3 RELATED WORK:

A. Refer to all sections of work on this project.

1.4 SUBMITTALS:

A. Paint Samples: Provide the Architect with draw-down samples upon receipt of the paint schedule, listing colors. Submit two sets of samples for Architect's review of color, sheen and texture for approval.

B. Manufacturer: Provide the name of the manufacturer(s) proposed for this project for acceptance.

1.5 QUALITY ASSURANCE:

A. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use only thinners approved by paint manufacturer, and use only within recommended limits.

B. Coordination of Work: Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates.

C. Materials shall conform with the Master Painters Institute (MPI) all applicable sections.

D. UL 2818(2013) GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings

1.6 DELIVERY AND STORAGE:

A. Deliver materials to job site in original, new and unopened packages and containers bearing manufacturer's name and label, and information regarding color, number, instructions, stock number, and any other applicable data.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage of paint in a clean condition, free of foreign materials and residue.

C. Protect from freezing where necessary. Store all products in suitable temperature range as indicated in manufacturer's data. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all precautions to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of paints.

1.7 JOB CONDITIONS:

A. In general, do not apply any paint system unless the air temperature is above 40 degrees for three consecutive days. Refer to specific, more stringent requirements for various paint systems.

B. Apply water-based paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50°F (10°C) and 90°F (32°C), unless otherwise permitted by paint manufacturer's printed instructions.

C. Apply solvent-thinned paints only when temperature of surfaces to be painted and surrounding air temperatures are between 45°F (7°C) and 95°F (35°C), unless otherwise permitted by paint manufacturer's printed instructions.

D. Do not apply paint in snow, rain, fog or mist, or when relative humidity exceeds 85%, or to damp or wet surfaces, unless otherwise permitted by paint manufacturer's printed instructions.

PART 2 – PRODUCTS

2.1 MANUFACTURERS (PAINTS):

A. Benjamin Moore and Co. (Moore).
B. Cabots
C. California Paints.
D. Diamond Vogel Paints.
E. Hirshfields Paints.
F. ICI Paints
G. PPG Industries, Pittsburgh Paints (Pittsburgh).
H. Pratt and Lambert (P & L).
I. Sherwin-Williams Co.

2.2 MATERIALS:

A. Material Quality: Provide best commercial quality grade of various types of coatings as regularly manufactured by acceptable paint materials manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.

B. Proprietary names used to designate color or materials are not intended to imply that products of named manufacturers are required to exclusion of equivalent products of other manufacturers.

C. Federal Specifications establish minimum acceptable quality for paint materials. Provide certification that paint materials provided meet or exceed these minimums.

D. Color Pigments: Pure, non-fading, applicable types to suit substrates and service indicated.

E. Provide primers at all locations and block-filler at the concrete masonry units as recommended by the manufacturer.

2.3 SPECIAL COATINGS:

A. Epoxy Coating:

1. Provide industrial strength zero VOC, 100% solids high build-up epoxy coating applied at a rate of 160 to 200 sf per gallon.
2. Provide a two-coat application in compliance with manufacturer’s instructions.

PART 3 – EXECUTION

3.1 INSPECTION:

A. Applicator must examine areas and conditions under which painting work is to be applied and notify Contractor in writing of conditions detrimental to proper and timely completion of work. Do not proceed with work until unsatisfactory conditions have been correct in a manner acceptable to Applicator. Starting of painting work will be construed as Applicator's acceptance of surfaces and conditions within any particular area.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to formation of a durable paint film.

C. Do not paint over any code-required labels.

3.2 SURFACE PREPARATION:

A. General: Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as herein specified, for each particular substrate condition.

B. Remove hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted. Following completion of painting of each space or area, reinstall removed items. Clean surfaces to be painted before applying paint.

C. Ferrous Metals: Clean ferrous surfaces, which are not galvanized or shop-coated. Touch-up shop-applied prime coats wherever damaged or bare, where required by other sections of these specifications. Clean and touch-up with same type shop primer.

3.3 APPLICATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. General: Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

C. Minimum Coating Thickness: Apply materials at not less than manufacturer's recommended spreading rate, to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

D. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.4 FIELD QUALITY CONTROL:

A. Owner reserves the right to test the work. If test results show that material being used does not comply with specified requirements, Contractor may be directed to stop painting work, and remove non-complying paint; pay for testing; repaint surfaces coated with rejected paint; remove rejected paint from previously painted surfaces if, upon repainting with specified paint, the two coatings are non-compatible. This shall be strictly enforced.

3.5 CLEAN-UP AND PROTECTION:

A. Clean-Up: During progress of work, remove from site discarded paint materials, rubbish, cans and rags at end of each work day. Upon completion of painting work, clean window glass and other paint spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.

B. Protection: Protect work from other trades and from the public, through the use of barricades, signs and other forms of protection. Correct any damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

1. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

C. At completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

3.6 PAINT SCHEDULE:

A. General: Provide the following Paint systems for the various substrates, as indicated. Supply paint equal to those listed below, but only from approved list of "manufacturers" listed above.

1. Ferrous Metal:

a. Prime Coat: Zinc chromate primer (not required for factory primed steel).

b. 1st/ 2nd Finish Coats: 100% acrylic semi-gloss enamel, with deep tone base as required, depending on color.

2. Interior Masonry and concrete: Semi-gloss/low luster, 100% acrylic paint: 2 coats over block filler/ primer as applicable.

3. Interior Drywall: All-purpose stain-hiding latex primer with 2 coats of 100% acrylic latex paint in a low-luster finish.

4. Interior Wood Deck / Ceiling, Joists and Structural Steel: 1 full-coverage coat of “dry-fall” paint.

5. Selected walls/ceiling - Wash bay area: Epoxy paint: Epoxy coating.

END OF SECTION 09 90 00

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SECTION 09 97 20 – FIBERGLASS REINFORCED WALL PANELS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes prefinished polyester glass reinforced plastic sheets, PVC trim and accessories for a complete installation.

1.2 RELATED SECTIONS

A. All Division 6 sections.

1.3 REFERENCES

A. American Society for Testing and Materials: Standard Specifications (ASTM)
   1. ASTM D 256 - Izod Impact Strengths (ft #/in)
   2. ASTM D 570 - Water Absorption (%)
   3. ASTM D 638 - Tensile Strengths (psi) & Tensile Modulus (psi)
   4. ASTM D 790 - Flexural Strengths (psi) & Flexural Modulus (psi)
   5. ASTM D 2583- Barcol Hardness
   6. ASTM D 5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels.
   7. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

1.4 SUBMITTALS

A. Product Data.

B. Shop Drawings: Submit elevations of each wall showing location of paneling and trim members with respect to all discontinuities in the wall elevation.

C. Selection Samples: Submit manufacturer’s standard color pattern selection samples representing manufacturer's full range of available colors and patterns.

D. Samples for Verification: Submit actual sample of color/pattern selected by the Architect.

1.5 QUALITY ASSURANCE

A. Conform to building code requirements for interior finish for smoke and flame spread requirements as tested in accordance with:
   1. ASTM E 84 (Method of test for surface burning characteristics of building Materials)
      a. Wall Required Rating – Class [A] [C].

B. Sanitary Standards: System components and finishes to comply with:
   1. United States Department of Agriculture (USDA) requirements for food preparation facilities, incidental contact.
   2. Food and Drug Administration (FDA) 1999 Food Code 6-101.11.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver materials factory packaged on strong pallets.

B. Store panels and trim lying flat, under cover and protected from the elements. Allow panels to acclimate to room temperature (70°) for 48 hours prior to installation.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Building are to be fully enclosed prior to installation with sufficient heat (70°) and ventilation consistent with good working conditions for finish work

B. During installation and for not less than 48 hours before, maintain an ambient temperature and relative humidity within limits required by type of adhesive used and recommendation of adhesive manufacturer.

1. Provide ventilation to disperse fumes during application of adhesive as recommended by the adhesive manufacturer.

1.8 WARRANTY

A. Furnish one-year guarantee against defects in material and workmanship.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. Subject to compliance with requirements, provide one of the following:

1. Crane Corporate
2. Marlite
3. Approved equal

2.2 PANELS

A. Fiberglass reinforced thermosetting polyester resin panel sheets complying with ASTM D 5319.

1. Coating: Multi-layer print, primer and finish coats or applied over-layer.
2. Dimensions:
   a. Thickness: 0.090 “ (2.29mm) nominal
   b. Width: 4'-0” (1.22m) nominal
   c. Length: as required
3. Tolerance:
   a. Length and Width: +/-1/8 “ (3.175mm)
   b. Squareness: Not to exceed 1/8 “ for 8 foot (2.4m) panels or 5/32 “ (3.96mm) for 10 foot (2.4m) panels

B. Properties: Resistant to rot, corrosion, staining, denting, peeling, and splintering.

1. Flexural Strength - 1.0×10^4 psi per ASTM D 790. (7.0 kilogram-force/square millimeter)
2. Flexural Modulus - 3.1×10^5 psi per ASTM D 790. (217.9 kilogram-force/square millimeter)
3. Tensile Strength - 7.0×10^3 psi per ASTM D 638. (4.9 kilogram-force/square millimeter)
4. Tensile Modulus - 1.6×10^5 psi per ASTM D 638. (112.5 kilogram-force/square millimeter)

5. Water Absorption - 0.72% per ASTM D 570.
6. Barcol Hardness (scratch resistance) of 35 55 as per ASTM D 2583.
7. Izod Impact Strength of 72 ft. lbs./in ASTM D 256

C. Back Surface: Smooth.

D. Front Finish: Architect shall choose a finish from complete line of Designer Series panels.

E. Color: Architect shall choose from a complete list of colors with a minimal of 30 colors.

F. Fire rating: Fire rated panels are not required on this project.

G. PVC Trim: Thin-wall semi-rigid extruded PVC for inside corners, outside corners, edges, end conditions and other trim sections as needed for a complete installation. Trim shall match color of panel materials.

2.3 ACCESSORIES

A. Fasteners: To be only used at concealed locations or where adhesive applications will not work. Non-staining nylon drive rivets.

1. Match panel colors.
2. Length to suit project conditions.

B. Adhesive: Product as recommended by the manufacturer.

C. Sealant: Refer to section on Sealers or provide silicone as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Examine backup surfaces to determine that corners are plumb and straight, surfaces are smooth, uniform, clean and free from foreign matter, nails countersunk, joints and cracks filled flush and smooth with the adjoining surface.

B. Repair defects prior to installation. Level wall surfaces to panel manufacturer’s requirements. Remove protrusions and fill indentations.

3.2 INSTALLATION

A. Comply with manufacturer's recommended procedures and installation sequence.

B. Cut sheets to meet supports allowing 1/8” (3 mm) clearance for every 8 foot (2.4m) of panel.

1. Cut and drill with carbide tipped saw blades or drill bits, or cut with shears.
2. Pre-drill fastener holes 1/8” (3mm) oversize with high speed drill bit.
    a. Space at 8” (200mm) maximum on center at perimeter, approximately 1” from panel edge.
    b. Space at in field in rows 16’ (40.64cm) on center, with fasteners spaced at 12” (30.48 cm) maximum on center.

C. Apply panels to board substrate, above base, vertically oriented with seams plumb and pattern aligned with adjoining panels.

1. Install panels with manufacturer's recommended gap for panel field and corner joints.
   a. Adhesive trowel and application method to conform to adhesive manufacturer’s recommendations.
   b. Drive fasteners for snug fit. Do not over-tighten.

D. Apply panel moldings to all panel edges using silicone sealant providing for required clearances.

1. All moldings must provide for a minimum 1/8” (3mm) of panel expansion at joints and edges, to insure proper installation.
2. Apply sealant to all moldings, channels and joints between the system and different materials to assure watertight installation.

3.3 CLEANING

A. Remove excess sealant from panels and moldings. Wipe panel down using a damp cloth and mild soap solution or cleaner.

B. Refer to manufacturer's specific cleaning recommendations Do not use abrasive cleaners.

SECTION 10 28 00 - TOILET ACCESSORIES

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section Includes washroom accessories as shown on the drawings and as specified herein:

Grab bars
Framed mirrors

B. All other toilet accessories are provided and installed by the owner.

C. Accessories located within the showers are provided by the plumbing sections.

D. Refer to the drawings for locations, sizes quantities and details.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated including installation instructions.

B. Product Schedule: Indicating types, quantities, sizes by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

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.

1.7 WARRANTY

A. Special Framed Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc. (ASI)
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

2.2 PRODUCTS

A. Grab Bars: L-shaped and special shapes to meet ADA and State of MN Accessibility requirements:
1. Mounting: Flanges with concealed fasteners.
2. Material: Stainless steel, 0.05 inch thick.
3. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
4. Outside Diameter: 1-1/2 inches.
5. Configuration and Length: As indicated on Drawings.

B. Framed Mirror Units: ¼” thick polished mirror glass, AIS-0600-2436
1. Frame: Stainless-steel channel. No. 4 finish (satin)
2. Corners: Manufacturer's standard.
3. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.
   a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
4. Size: As indicated on Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units so they are level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested (ASTM F 446).

END OF SECTION 10 28 00

SECTION 10 50 00 - METAL LOCKERS AND EQUIPMENT

PART 1 – GENERAL

1.01 RELATED DOCUMENTS:

A. The drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY:

A. Section includes lockers and accessories as follows:

1. Metal lockers, with vented doors/sides, integral foot gear door and flush base.
2. Wood benches

B. This section is to be bid as an alternate.

1.3 ACTION SUBMITTALS:

A. Product Data: Manufacturer's and installation instructions.

B. Color Charts: Submit manufacturers color chart for reference by the Architect.

C. Samples: Color samples of selected metal finish for the lockers, and wood with selected finish for benches.

D. Shop Drawings: Show lockers in detail, method of installation, fillers, trim, base, and accessories. Include locker numbering sequence information. Show typical bench layout, dimensions and details.

1.4 INFORMATIONAL SUBMITTALS:

A. Product Certificates

1.5 CLOSEOUT SUBMITTALS:

A. Maintenance Data

1.6 QUALITY ASSURANCE:

A. Uniformity: Provide each type of metal locker as produced by a single manufacturer, and benches as produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.

B. Comply with ASTM A366 for carbon steel and ASTM A446 for galvanized steel.

1.7 JOB CONDITIONS:

A. Do not deliver metal lockers until building is enclosed and ready for locker installation. Protect from damage during delivery, handling, storage, and installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Subject to compliance with the specifications, manufacturers are allowed to bid where an open spec is indicated. Manufacturers shall submit their data along with a request for approval during the bidding phase. Manufacturers differ from one to another, especially relative to assembly and customer service and the Architect will pre-qualify manufacturers.

B. Basis of design: The specification is based on Salsbury Industries Standard Gear Lockers.

2.2 MATERIALS:

LOCKERS AT LOCKER ROOMS:

A. Locker systems: Lockers are gear type with vented doors and sides, knock-down type. Units are pre-finished steel with solid rear panel, expanded mesh side panels and door. One internal shelf and hooks shall be provided at all full height lockers.

1. Full height units: One shelf, rod, two hooks at the interior and one hook mounted on the door. Full height lockers shall be a nominal 24" x 24" x 6' tall, with 4” tall base.

2. Units shall include an integral vented door and sides. Units shall have a minimum of 40% openings for ventilation.

3. All lockers and foot lockers shall have a provision for user-provided locks.

4. Provide single tier and double tier units as shown on the drawings.

B. Steel materials for frames and doors: Provide cold-rolled steel for all body parts, except as noted. All shelves, bottoms and tier dividers shall be of galvanealed construction. Indicate such on the shop drawings. Components shall have the minimum requirements:

1. Doors: 16 gage steel, vented per manufacturer’s standard design.

2. Tops, sides and intermediate walls: 16 gauge steel

3. Bottoms, shelves and tier dividers: 16 gauge steel

4. Backs: 18 gauge steel

5. Latch: Recessed with finger lift accepts owner-provided lock, all door latches to be ADA accessible.

6. Hinge: 2" wide, 5 knuckle type

7. Exposed ends (as applicable): 16 gauge full single sheet with holes for attachment only

8. Base: “Z” type, continuous 14 gauge, 4” high closed base in metal finish to match lockers.

9. Fasteners: Cadmium, zinc, or nickel plated steel; exposed bolt heads, slotless type; self-locking nuts or locker washers for nuts on moving parts.

10. Shelf: One per full height locker. One locker at each restroom to have a removable shelf which can be relocated to ADA accessible height.

11. Hooks: Two per locker.

12. Number plates: Manufacturer's standard number plates. Provide plates numbering 1, 2, 3 and so on.

13. Filler units: Provide prefinished steel filler panels as needed in order to fully enclose the assembled locker units within the areas shown on the drawings.

C. Finish: Architect shall select **two** colors from a minimum of 3 standard colors submitted by the manufacturer, whether standard or custom colors.

2.3 FABRICATION OF LOCKERS:

A. Construction: Fabricate lockers square, rigid, and without warp, or distortion. Smooth all exposed metal edges. Weld frame members together to form rigid, one-piece structure, but do not use expose bolts or rivet heads on fronts of locker doors or frames. Provide a minimum of three (five knuckle) butt hinges per door.

B. Finishing: Chemically pre-treat metal with degreasing and phosphatizing process. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plates and non-ferrous metal.

1. Architect shall select three colors from a minimum of 12 standard colors submitted by the manufacturer, whether standard or custom colors. Color of frames and accessories shall match the door color, as selected from a minimum of 3 colors.

C. Body: Fabricate back and sides with double-flanged connections extending full height. Provide sheet hat shelf. Form exposed ends of non-recessed lockers of minimum 16-gage steel.

D. Door: Construct to prevent springing when opening or closing. Fabricate to swing 180^{o}. Include 1-1/2 pair of heavy-duty full-loop, 5-knuckle, tight pin hinges. Weld to inside of frame and secure to door with tamper proof fasteners.

E. Equipment: Provide a mounted number plate for each door. Indicate numbering sequence on shop drawings.

2.4 MATERIALS: BENCHES:

A. Provide laminated hardwood, select maple units, sized 20" x 42", or as shown on the drawings, 1-1/8" thick minimum. Equip with painted steel pedestal supports at approximately 5' on center, or as required. Apply high quality transparent finish to all exposed wood. Include all fasteners and anchors. Anchor to concrete floor as recommended by the manufacturer.

PART 3 - EXECUTION

3.1 PREPARATION:

A. Field Measurements: Take field measurements prior to fabrication. Allow for adjustment and fitting of trim and filler panels.

3.2 INSTALLATION:

A. Install metal lockers at locations shown in accordance with manufacturer's instructions for plumb, level, rigid, and flush installation. Provide reinforcing plates where necessary to avoid metal distortion; conceal fasteners insofar as possible.

B. Install trim, metal base, and metal filler panels where indicated, using concealed fasteners to provide flush, hairline joints against adjacent surfaces.

3.3 ADJUSTING AND CLEANING:

A. Adjust doors and latches to operate easily without binding. Verify that integral locking devices are operating properly.

B. Touch-up marred finishes but replace units which cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 50 00

SECTION 10 65 00 OPERABLE PARTITION

PART 1 – GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY / DESCRIPTION

A. Section includes furnishing and installing operable partition and suspension system, including all labor, materials, tools, equipment, and services for operable walls in accordance with provisions of contract documents.

B. This section is to be bid as an alternate. As a deduct, rooms #112 and #112A will have an opening between the two rooms with ceiling continuous across both rooms.

1.3 SUBMITTALS

A. Shop drawings: Include layout plans, standard conditions, special conditions and details.
B. Samples: Fabric samples.

1.4 QUALITY ASSURANCE

A. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions
B. The partition STC (Sound Transmission Classification) shall be achieved per the standard test methods ASTM E90.
C. Noise isolation classifications shall be achieved per the standard test methods ASTM E336 and ASTM E413.
D. Noise Reduction Coefficient (NRC) ratings shall be per ASTM C423.
E. Rack testing for 10 years. (tensional strength stress test)
F. The manufacturer shall have a quality system that is registered to the ISO 9001 standards.

1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Proper storage of partitions before installation and continued protection during and after installation will be the responsibility of the General Contractor.

1.6 WARRANTY

A. Partition system shall be guaranteed for a period of two years against defects in material and workmanship, excluding abuse.

PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Upon compliance with all of the criteria specified in this section, provide one of the following:

1. Hufcor

2. Approved equal.

2.2 MATERIALS

A. Product shall include a top supported operable partition system. Design is based on Series 641 individual, Omni-directional panels as manufactured by Hufcor Inc.

1. Panels shall be nominally 4" thick and a nominal 48" in width.
2. Panel faces shall be laminated to appropriate substrate to meet the STC requirement in 2.04 Acoustical Performance.
   a. Provide manufacturer's standard substrate material.
3. Frames shall be of 16 gauge painted steel with integral factory applied aluminum vertical edge and face protection.
4. Vertical sound seals shall be of tongue and groove configuration, ensure panel-to-panel alignment and prevent sound leaks between panels.
5. Horizontal top seals shall be retractable. Provide 1" nominal operating clearance, and exert upward force when extended. All panels, including pass door panels and lever closure panels must have retractable top and bottom seals.
6. Horizontal bottom seals shall be retractable. Provide up to 2" nominal operating clearance, and exert downward force when fully extended. Optional:
   a. Horizontal bottom seals shall be retractable, provide 4" nominal operating clearance, and exert 97 lbs. [44 kg] downward force when fully extended.
   b. Horizontal bottom seals shall be fixed continuous contact 4-finger vinyl.
7. Horizontal trim shall be of aluminum.

B. Weight of the panels shall be 7.8-13.6 lbs./sq. ft. [37.8.2-66.4 kg/sq.m].

C. Suspension system:
1. Track shall be of clear anodized architectural grade extruded aluminum alloy 6063-T6. Track design shall provide precise alignment at the trolley running surfaces and provide integral support for adjoining ceiling, soffit, or plenum sound barrier. Track shall be connected to the structural support by pairs of minimum 3/8" dia. threaded steel hanger rods. Pairs of rods are directly attached to the track, no single point attachment allowed. L, T, or X intersections shall be factory assembled and welded.
   a. Each panel shall be supported by two 2-wheeled counter-rotating horizontal carriers. Wheels to be of precision ground steel ball bearings with heat treated and hardened races encased with molded polymer tires.

D. Finishes
1. Face finish shall be a factory applied reinforced vinyl fabric with woven backing, weighing not less than 15 oz. per lineal yard [465 g/m]. Color shall be selected from manufacturer's standard color selections.
2. Exposed metal trim and seal color shall be as selected by the Architect.
3. Aluminum track shall be in white color.

2.3 OPERATION

A. Panels shall be manually moved from the storage area, positioned in the opening, and seals set.

B. Retractable Horizontal Seals
1. Retractable horizontal seals shall be activated by a removable quick-set operating handle located approximately 42" from the floor in the panel edge.
2. Top and bottom retractable seals shall be operated simultaneously.
3. Seal activation requires approximately a 190 degree turn of the removable handle.

C. Final partition closure to be by lever closure panel with expanding jamb which compensates for minor wall irregularities and provides a minimum of 250 lbs. [113.4 kg] seal force against the adjacent wall for optimum sound control. The jamb activator shall be located approximately 45" from the floor in the

panel face and be accessed from either side of the panel. The jamb is equipped with a mechanical rack and pinion gear drive mechanism and shall extend 4”-6” by turning the removable operating handle.

D. Stack/Store Panels: Provide retractable seals with removable operating handle and move to storage area.

2.4 ACOUSTICAL PERFORMANCE

A. Acoustical performance shall be tested at a laboratory accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) and in accordance with ASTM E90 Test Standards. Standard panel construction shall have obtained an STC rating of 52.
   1. Complete, unaltered written test report is to be made available upon request.

PART 3 – EXECUTION

3.1 INSTALLATION / MOUNTING CONDITIONS

A. Verify that the beam, walls, floor and other conditions are true and plumb, or acceptable for proper installation of the system. Do not proceed until the conditions are acceptable.

B. The complete installation of the operable wall system shall be by an authorized factory-trained installer and shall be in strict accordance with the approved shop drawings and manufacturer’s standard printed specifications, instructions, and recommendations.

C. System shall be installed per the manufacturer’s recommendations. Panels shall be installed so that they are plumb, true to level, even and move as intended. Make adjustments as necessary so that the panels move in a smooth and even manner, readily operable by any adult.

D. Cleaning: Upon completion perform the following:

   1. All track and panel surfaces shall be wiped clean and free of handprints, grease, and soil.
   2. Cartons and other installation debris shall be removed to onsite waste collection area, provided by others.

C. Training: As a requirement of this section, perform the following:

   1. Installer shall demonstrate proper operation and maintenance procedures to owner’s representative.
   2. Operating handle and owner’s manuals shall be provided to owner’s representative.

END OF SECTION 10 65 00

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SECTION 12 35 30 - ARCHITECTURAL CASEWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes factory made cabinets, trim and related hardware. Cabinets shall be surfaces with plastic laminate in colors as selected by the Architect.

B. Section also includes plastic laminate countertops, back-splashes and side-splashes.

1.3 RELATED SECTIONS

A. Section 06 20 23, Finish Carpentry

B. Section 12 35 35, Solid Polymer Fabrications.

1.4 DEFINITIONS

A. MDF: Medium-density fiberboard.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Cabinets.
2. Cabinet hardware.

B. Shop Drawings: Include plans, elevations, details, and attachments to other work. Show materials, finishes, filler panels, and hardware.

C. Samples of plastic laminate for selection.

1.6 REFERENCES AND STANDARDS

A. KITCHEN CABINET MANUFACTURERS ASSOCIATION (KCMA): KCMA A161.1 (2017) Performance & Construction Standards for Kitchen and Vanity Cabinets

B. BUILDERS HARDWARE MANUFACTURERS ASSOCIATION (BHMA): ANSI/BHMA A156.9 (2015) Cabinet Hardware

PART 2 - PRODUCTS

2.1 CABINETS

A. Quality Standard: Provide cabinets that comply with KCMA A161.1.

1. KCMA Certification: Provide cabinets with KCMA's "Certified Cabinet" seal affixed in a semi-exposed location of each unit and showing compliance with the above standard.

B. Face Style: Flush overlay style.

C. Drawer fronts, doors, panels and related:
1. Plastic laminate.

D. Shelves and interior surfaces:
1. Finish plywood, particle board or tempered hardboard cabinet backs with a melamine laminate on the exposed side. Cover particle board shelves on both sides with a laminated melamine finish. Provide Melamine laminate that conforms to the requirements of ANSI/NEMA LD 3 and laminate adhesive that is contact type applied to both surfaces.

E. Countertops: Plastic laminate.

2.2 CABINET MATERIALS

A. System description:

1. Provide factory-fabricated and finished in the manufacturer's standard sizes and finishes of the type, design, and configuration indicated on drawings. Construct cabinets as specified meeting the requirements of KCMA A161.1. Provide wall and base cabinet assemblies consisting of individual units joined into continuous sections. Use fastenings that permit removal and replacement of individual units without affecting the remainder of the installation.

B. Cabinet fabrication and materials:

1. Adhesives and Composite Wood and Agrifiber Products: Do not use products that contain urea formaldehyde.
2. Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
3. Hardwood Lumber: Kiln dried to 7 percent moisture content.
4. Hardwood Plywood: HPVA HP-1made with adhesive containing no urea formaldehyde.
5. Medium density fiberboard.

C. Materials: Unless otherwise indicated, provide the following:

1. Concealed Materials: Solid wood or plywood, of any hardwood or softwood species, with no defects affecting strength or utility.
2. High pressure decorative laminate: ANSI / NEMA LD3 impervious, stain-resistant composite materials.

2.3 CABINET HARDWARE

A. General: Provide quality, commercial grade hardware as shown, specified or as required for a complete installation including pulls, glides, brackets, hinges and drawer locks. Finish to be brushed chrome unless specified otherwise or chrome is brushed materials are not available.

B. All hardware shall comply with ANSI / BHMS A156.9

C. Pulls: 4” Wire pulls.

D. Hinges: Concealed Silentia, Soss or Blum adjustable, self-closing to suit the condition.

E. Drawer Guides: Accuride, Silentia or Blum, under-mount type, with full extension drawers, adjustable and removable. All drawers with a drawer face panel larger than 220 sq. inches shall have extra heavy-duty glides. Units shall include soft-close return feature.

F. Brackets: Heavy duty steel angle brackets, prefinished in color as selected by Architect.

G. Shelf supports: 1/4" inset chrome type.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cabinets with no variations in flushness of adjoining surfaces; use concealed shims. Where cabinets abut other finished work, scribe and cut for accurate fit. Provide filler strips, scribe strips, and moldings in finish to match cabinet face.

B. Install cabinets without distortion so doors and drawers fit the openings, are aligned, and are uniformly spaced. Complete installation of hardware and accessories as indicated.

C. Install cabinets level and plumb to a tolerance of 1/8 inch in 8 feet.

D. Fasten cabinets to adjacent units and to backing.

1. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inchpenetration into wood framing, blocking, or hanging strips.

3.2 ADJUSTING AND CLEANING

A. Adjust cabinets and hardware so doors and drawers are centered in openings and operate smoothly without warp or bind. Lubricate operating hardware as recommended by manufacturer.

END OF SECTION 12 35 30

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SECTION 31 00 00 - EARTHWORK AND SITE CLEARING

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. The Drawings, the provisions of the Contract including the General and Supplementary Conditions, and the General Requirements apply to the Work of this Section.

B. Minnesota Department of Transportation's Standard Specifications for Construction, latest edition.

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 DESCRIPTION OF WORK:

A. Section includes reference to earthwork as indicated on drawings and described in this and other Division 31 sections, including work scope: grading, cutting/filling, trenching, backfilling, compaction and related work, along with a minor amount of landscape related items, summarized as follows:

1. *Protection of trees, shrubs and associated plant materials that are within work limits.*
2. *De-watering as necessary based on site conditions.*
3. *Erosion control.*
4. *Excavating the soils at the new work.*
5. *Trenching for new underground work.*
6. *Cutting and removing soils and associated work throughout the site to establish new grades.*
7. *Stockpiling soils, if in excess of that needed, at a location near the building site.*
8. *Excavating, trenching, back-filling and compaction of soils for the building addition, and for all other work on site.*
9. *Backfill and compaction.*
10. *Site clearing at areas shown or implied on the civil and architectural site plans.*
11. *Maintaining storm water controls and associated permits for the duration of the work.*

B. Refer to the soils information included within this project manual for pertinent information related to the earthwork. The work of this section includes soil correction of the inferior soils at the building, including but not limited to import / export of soils.

C. Contacting Gopher 1 is required prior to any work being performed. Also, contact the city representative to confirm any buried lines that are not covered by Gopher 1.

1.3 RELATED WORK:

A. All other Division 31-33 Sections.
B. Refer to Geotechnical Boring Data bound within this specification.

1.4 QUALITY ASSURANCE:

A. Codes and Standards: Perform excavation work in compliance with applicable requirements of governing authorities having jurisdiction. Perform all work in compliance with local jurisdictions.

B. Testing and Inspection Service: Owner will retain a soil testing and inspection service for quality control testing during earthwork operations. Contractor shall be responsible for the coordination of this service.

1. Gopher State One Call: By law, Contractor shall contact Gopher One System Notification Center 48 hours prior to any excavation or sitework. Telephone: 1-800-252-1166.

1.5 SUBMITTALS:

A. Test Reports-Excavating: Promptly submit following reports directly to Architect and Owner:

1. Test reports on borrow material.
2. Verification of each footing subgrade.
3. Field density test reports.
4. One optimum moisture-maximum density curve for each type of soil encountered.
5. Results of survey activities.

1.2 JOB CONDITIONS:

A. Site Layout: Contractor shall hire a licensed surveyor to establish and maintain benchmarks, monuments and stakes for the layout of the project.

B. Site Geotechnical Information: Data on indicated subsurface conditions are not intended as representations or warranties of accuracy or continuity between information provided in the project manual. It is expressly understood that Owner will not be responsible for interpretations or conclusions drawn therefrom by Contractor. Data are made available for convenience of Contractor.

1. A Geotechnical Engineer will be available during the earthwork operations, paid by the Owner, coordinated by the Contractor.

2. Additional test borings and other exploratory operations may be made by Contractor at no cost to Owner.

C. Should uncharted, or incorrectly charted, piping or other utilities be encountered during excavation, consult utility owner immediately for directions. Cooperate with owner and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility company.

D. Protection of Persons and Property: Barricade open excavations occurring as part of this work and post with city approved warning lights. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout and other hazards created by earthwork operations.

E. Silt Fences: Contractor shall furnish, install and maintain silt fence as required or as indicated on the drawings, and in accordance with MNDOT and NPDES standards, as required to minimize wash out of existing grade.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Provide and reuse satisfactory soil materials complying with ASTM D2487.

B. Unsatisfactory soil materials are defined as those not in conformance with ASTM D2487.

C. Aggregate Base course: Class 5 or 7 per MnDOT 2211 and 3138. Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, natural or crushed sand.

D. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100% passing a 1-1/2" sieve and not more than 5% passing a No. 4 sieve.

E. Backfill and Fill Materials: Below all slabs and adjacent to all underground walls, provide satisfactory soil materials, mostly free of fat clay, rock or gravel larger than 2" in any dimension, debris, waste, frozen materials, organic and other deleterious matter. Provide evenly graded, clean granular soil materials with not more than 5% passing No. 200 sieve.

F. Fill below slabs: 6" minimum depth of clean sand per MnDOT 3149.2 B2, with less than 5% passing a No. 200 sieve.

PART 3 - EXECUTION

3.1 EXCAVATION:

A. Provide de-watering equipment and operations to maintain dry trenches.

B. Excavation for structures: conform to elevations and dimensions shown within a tolerance of +/- 0.10', and extending a sufficient distance from footings and foundations to permit placing and removal of concrete formwork, installation of services, other construction, and for observation.

C. Excavation for engineered fill shall be laterally oversized beyond the outer edge of the footing at least one foot for each foot of excavation below the bottom of footing.

D. Under footings, foundation bases, or retaining walls, fill unauthorized excavation by extending indicated bottom elevation of footing or base to excavation bottom, without altering required top elevation. Lean concrete fill may be used to bring elevations to proper position, when acceptable to Architect/Engineer.

E. Elsewhere, backfill and compact unauthorized excavations as specified for authorized excavations of same classification, unless otherwise directed by Project Geotechnical Engineer or Architect. If unsuitable bearing materials are encountered at required subgrade elevations, carry excavations deeper and replace excavated material as directed by Project Geotechnical Engineer.

F. Stability of Excavations: Slope sides of excavations to comply with local codes and ordinances having jurisdiction. Shore and brace where sloping is not possible because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in safe condition until completion of backfilling.

G. Dewatering: As required during construction operations, prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

H. Do not allow water to accumulate in excavations. Remove water to prevent softening of foundation bottoms, undercutting footings, and soil changes detrimental to stability of subgrades and foundations. Provide and maintain pumps, well points, sumps, suction and discharge lines, and other dewatering system components necessary to convey water away from excavations.

I. Contractor shall provide settling basins as needed to control the suspended solids in construction dewatering discharges as required by regulating agencies.

J. Grade bottoms of trenches as indicated, notching under pipe bells to provide solid bearing for entire body of pipe.

K. Unless otherwise shown, backfill trenches with concrete where trench excavations pass within 18" of column or wall footings and which are carried below bottom of such footings, or which pass under wall footings. Place concrete to level of top of adjacent footing. Concrete is specified in Division 3.

L. Do not backfill trenches until tests and inspections have been made and backfilling authorized by Project Geotechnical Engineer. Use care in backfilling to avoid damage or displacement of pipe systems.

3.2 COMPACTION:

A. General: Control soil compaction during construction providing minimum percentage of density specified for each area classification indicated below.

B. Percentage of Maximum Density Requirements: ASTM D 698 (Standard Proctor).

1. Structures, Building Slabs, Retaining, Walls, Steps and Pavements: Compact all fill in approximately 6" to 12" lifts, or compact fill placed below 2000 psf + footings to at 100% of its maximum density according to ASTM D 698. Fill placed within 3 feet of pavement subgrade elevation should be compacted 100% of maximum density. Fill placed more than 3 feet below pavement subgrade elevation, shall be compacted to at least 95%. Compact all fill placed against retaining walls to at least 95% maximum density (ASTM D698). However, to avoid exerting excessive lateral pressure against newly constructed walls, the compacted density of the fill shall not exceed 98%.

2. Lawn or Unpaved Areas: Compact top 6" of subgrade and each layer of backfill or fill material at 80% minimum and 85% maximum density.

C. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water to surface of subgrade, or layer of soil material. Apply water in manner to prevent free water appearing on surface during or subsequent to compaction operations. Fill that is placed wet shall consist of less than 5% passing #200 sieve, and no more than 40% passing #40 sieve. Refer to soil report.

D. Remove and replace, or scarify and air dry, soil material that is too wet to permit compaction to specified density. Soil material that has been removed because it is too wet to permit compaction may be stockpiled or spread and allowed to dry. Assist drying by discing, harrowing or pulverizing until moisture content is reduced to a satisfactory value.

3.3 BACKFILL AND FILL:

A. General: Place acceptable material in layers to required subgrade elevations, for each item below.

1. In excavations and landscaped areas, use satisfactory excavated or borrow material: provide new imported fill as required in order to meet the specified densities.

2. Under pavements, use sub base material, or satisfactory excavated or borrow material per MnDOT 3149.2 B1, or combination of both.

3. Under building slabs, use granular materials which have been approved by the Geotechnical Engineer.

4. Under piping and conduit, use poorly graded sand material where subbase is indicated under piping or conduit; shape to fit bottom 180^{o} of cylinder per MnDOT 3149.2 G.

B. Ground Surface Preparation: Remove vegetation, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface prior to placement of fills. Plow, strip, or break-up sloped surfaces steeper than 1 vertical to 5 horizontal so that fill material will bond with existing surface.

1. Subcut any sandy clay, sandy lean clay or lean clay in the upper 3' of the subgrade and backfill with poorly graded sand, compact to 100% standard proctor. Verify depth with soil engineer.

2. Surface compact all fill areas prior to placement of any embankment and all cut areas at the hold down elevations in accordance with each particular area classification, break up ground surface, pulverize, moisture-condition to optimum moisture content, and compact to required depth and percentage of maximum density.

C. Placement and Compaction: Place backfill and fill materials in layers not more than 12" in loose depth for material compacted by heavy compaction equipment, and not more than 4" in loose depth for material compacted by hand-operated tampers.

1. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

2. Place backfill and fill materials evenly adjacent to structures, piping or conduit to required elevations. Take care to prevent wedging action of backfill against structures or displacement of piping or conduit by carrying material uniformly around structure, piping or conduit to approximately same elevation in each lift.

3.4 GRADING:

A. General: Uniformly grade areas within limits of grading under this section, including adjacent transition areas. Smooth finished surface within specified tolerances, compact with uniform levels or slopes between points where elevations are indicated, or between such points and existing grades.

B. Grading Outside Building Lines: Grade areas adjacent to building lines to drain away from structures and to prevent ponding.

1. Finish surfaces free from irregular surface changes, and as follows:

2. Pavements: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than ½" above or below required subgrade elevation.

C. Grading Surface of Fill Under Building Slabs: Grade smooth and even, free of voids, compacted as specified, and to required elevation. Provide final grades within a tolerance of ½" when tested with a 10' straightedge.

D. Compaction: Compact subgrade surfaces to the depth and indicated percentage of maximum density for each area classification.

3.5 PAVEMENT SUBBASE COURSE:

A. General: Subbase course consists of providing poorly graded sand in the upper 3 feet of the subgrade, in layers of specified thickness, to support a pavement base course. See other Division 2 sections for paving specifications.

B. Grade Control: During construction, maintain lines and grades including crown and cross-slope of subbase course.

C. Shoulders: Place shoulders along edges of subbase course to prevent lateral movement. Construct shoulders of acceptable soil materials, placed in such quantity to compact to thickness of each subbase course layer. Compact and roll at least a 12" width of shoulder simultaneously with compacting and rolling of each layer of subbase course.

D. Placing: Place subbase course material on prepared subgrade in layers of uniform thickness, conforming to indicated cross- section and thickness. Maintain optimum moisture content for compacting subbase material during placement operations.

1. When a compacted subbase course is shown to be 6" thick or less, place material in a single layer. When shown to be more than 6" thick, place material in equal layers, except no single layer more than 6" or less than 3" in thickness when compacted.

2. Cold Weather Protection: All snow and ice shall be removed from cut/fill areas prior to additional grading. No fill shall be placed on soils which have frozen material. No frozen soils shall be used as fill.

3.6 FIELD QUALITY CONTROL:

A. Quality Control Testing During Construction: Allow testing service to inspect and approve subgrades and fill layers before further construction work is performed. Owner shall pay for initial testing.

1. Perform field density tests in accordance with ASTM D 1556 (sand cone method) or ASTM D 2167 (rubber balloon method), as applicable.

2. Footing Subgrade: For each strata of soil on which footings will be placed, conduct at least one test to verify required design bearing capacities. Subsequent verification and approval of each footing subgrade may be based on a visual comparison of each subgrade with related tested strata, when acceptable to Architect/Engineer.

3. Paved Areas and Building Slab Subgrade: Make at least one field density test of subgrade for every 2000 sq. ft. of paved area or building slab, but in no case less than 3 tests. In each compacted fill layer, make one field density test for every 2000 sq. ft. of overlaying building slab or paved area, but in no case less than 3 tests.

4. Foundation Wall Backfill: Take at least 1 field density test for each 250 yards of backfill, at locations and elevations determined by Geotechnical Engineer.

B. If in opinion of Architect/Engineer, based on testing service reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense, until satisfactory. Contractor shall immediately correct any fill material not complying with the specification.

3.7 MAINTENANCE:

A. Protection of Graded Areas: Protect newly graded areas from traffic and erosion. Keep free of trash and debris.

1. Repair and re-establish grades in settled, eroded, and rutted areas to within specified tolerances.

B. Reconditioning Compacted Areas: Where completed compacted areas are disturbed by subsequent construction operations or adverse weather, scarify surface, re-shape, and compact to required density and moisture content prior to further construction.

C. Settling: Where settling is measurable or observable at excavated areas during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

END OF SECTION 31 10 00

SECTION 32 12 16 - ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Minnesota Department of Transportation's Standard Specifications for Construction, latest edition.

1.2 SUMMARY

A. Section Includes hot-mix asphalt paving.

B. This entire section is provided as an Alternate.

C. Refer to other Division 310000 and 320000 for related work.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include technical data and tested physical and performance properties.
2. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or MnDOT.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of MnDOT Specifications for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if base course is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).

3. Slurry Coat: Comply with weather limitations in ASTM D 3910.
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D 692/D 692M, sound; angular crushed stone or crushed gravel.

C. Fine Aggregate: ASTM D 1073 or AASHTO M 29, sharp-edged natural sand or sand prepared from stone, gravel or combinations thereof.

1. For hot-mix asphalt, limit natural sand to a maximum of 10 percent by weight of the total aggregate mass.

D. Mineral Filler: AASHTO M 17, rock dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: PG-58V-34

B. Tack Coat: MnDOT 2357.

C. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Recycled Materials for Hot-Mix Asphalt Mixes: At contractor's option provide reclaimed asphalt pavement; reclaimed, unbound-aggregate base material; from sources and gradations that have performed satisfactorily in previous installations, equal to performance of required hot-mix asphalt paving produced from all new materials.

B. Sand: ASTM D 1073, Grade No. 2 or No. 3.

2.4 MIXES

A. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by MnDOT and complies with Section 2360 from the MnDOT Standard Specifications for Construction, latest edition and complying with the following requirements:

1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Wear Courses: SPWEB440F

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll base course below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated base courses.

1. Completely proof-roll base course in one direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).

C. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared base course is ready to receive paving.

B. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.3 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course in number of lifts and thicknesses indicated.
2. Spread mix at a minimum temperature of 250 deg F (121 deg C).
3. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
4. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet (3 m) wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches (25 to 38 mm) from strip to strip to ensure proper compaction of mix along longitudinal joints.
2. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to ASTM D 6927, but not less than 94 percent or greater than 100 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.6 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Bottom Wear Course: Plus or minus 1/2 inch (13 mm).
2. Top Wear Course: Plus 1/4 inch (6 mm), no minus.

B. Pavement Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Bottom Wear Course: 1/4 inch (6 mm).
2. Top Wear Course: 1/8 inch (3 mm).

3.7 FIELD QUALITY CONTROL

A. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.

B. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances. Provide positive drainage across pavement surface. Correct deficiencies to satisfaction of the owner, including, but not limited to, correcting areas which pond water.

C. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

    a. One core sample will be taken for every 1000 sq. yd. (836 sq. m) or less of installed pavement, with no fewer than three cores taken.
    b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

D. Replace and compact hot-mix asphalt where core tests were taken.

E. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

F. Plant Inspections
1. Spot check at plant per 500 tons for virgin mixture.
2. Belt sample for gradation per 500 tons for virgin mixture.

G. In event the testing agency reports that materials or installation at each stage of construction do not comply with this Section, take whatever steps are necessary for compliance before proceeding further with paving installation.

END OF SECTION 32 12 16

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SECTION 32 13 10 - SITE CONCRETE

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1.2 SUMMARY

A. Section includes exterior site concrete including the following:

1. Curbs / gutters / storm drainage devices
2. Walkways
3. Sand cushion
4. Pavements

B. The base bid includes a concrete pavement area as shown on the drawings. An add alternate includes the deletion of this site slab, providing asphalt pavement at the entire Western portion of the building.

C. Work includes sealing / curing compounds as a part of the work.

1.3 RELATED WORK

A. Related Sections:
Section 310000, Earthwork
Section 079000, Joint sealants

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture. At least 7 days prior to first pour, submit all mix designs proposed for use on the project. Provide all necessary information, including the location of the proposed mix designs and a complete standard deviation analysis or trial mix test data.

PART 2 - PRODUCTS

2.1 BASE MATERIALS

A. Base Material: Clean washed sand suitable for the purpose.

2.2 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, gray. Only one brand of cement shall be used.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 1-1/2” nominal at footings and 6” slabs, 3/8” nominal at masonry concrete infill, 3/4" at all other locations (unless shown otherwise in structural drawings).

2. Minimum total coarse aggregate content for slabs on grade and topping slabs shall be 12 cubic feet per cubic yard for 1 ½” or larger top size aggregate; 11.5 cubic feet per cubic yard for top size aggregate 1 ¼” or larger but less than 1 ½”; 11 cubic feet per cubic yard for topsize aggregate 1” or larger but less than 1 ¼”; or 10.5 cubic feet per cubic yard for topsize aggregate less than 1”.

3. Combined aggregate gradation for slabs on grade, topping slabs, and other designated concrete shall be 8% - 18% for large top size aggregates (1½ in.) or 8% - 22% for smaller top size aggregates (1 in. or ¾ in.) retained on each sieve below the top size and above the No. 100. [1]

4. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94/C 94M and potable.

2.3 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 (superplasticizer): ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture (superplasticizer): ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.4 FIBER REINFORCEMENT

A. Synthetic Micro-Fiber: Fibrillated polypropylene micro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III. To be used in unison with macro synthetic fibers, reinforcing steel, or in non-reinforced concrete slabs, but shall not be considered as a replacement for WWF or reinforcing steel of any kind.

1. Products:
    a. Monofilament Fibers:
        1) Euclid Chemical Company (The); Fiberstrand 100.
        2) FORTA Corporation; Forta Mono.
        3) Grace Construction Products, W. R. Grace & Co.; Grace MicroFiber.
    b. Fibrillated Fibers:
        1) Euclid Chemical Company (The); Fiberstrand F.
        2) FORTA Corporation; Forta.
        3) Grace Construction Products, W. R. Grace & Co.; Grace Fibers.
        4) SI Concrete Systems; Fibermesh.

B. Micro-fiber products are to be used in the 4” thick slabs / walkways

2.5 CURING AND COATING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

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, Solvent-Borne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

1. VOC Content: Curing and sealing compounds shall have a low VOC content of 200 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.6 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber or ASTM D 1752, cork or self-expanding cork.

2.7 CONCRETE MIXTURES

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. Use an independent testing facility acceptable to Architect.

B. Cementitious Materials: Use fly ash, pozzolan, ground granulated blast-furnace slag, and silica fume as needed to reduce the total amount of Portland cement, which would otherwise be used, by not less than 25 percent.[1]

C. Admixtures: Use admixtures in strict compliance with manufacturer's written instructions.

1. Use water-reducing, retarding, accelerating, or plasticizing admixtures in concrete, as required, for placement and workability. Use a non-corrosive, non-chloride accelerator in slabs placed below 50 degrees F.
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. Provide air entrainment at all exterior concrete which is a part of this section, including aprons, at a rate of 6% +/1%.
5. Ready-Mix Materials: Comply with ASTM C 94. Contractor shall reject all concrete brought in by ready-mix truck that exceeds maximum allowable slumps and water-cement ratios, and the following limits:

60 minutes after inclusion of superplasticizer.
60 minutes for all concrete in temperatures exceeding 80 degrees.
90 minutes for all other concrete.
Re-tempering of Concrete is not allowed.[1]

D. Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: **4000 psi** at 28 days.
2. Maximum Water-Cementitious Materials Ratio: **.48**
3. Slump Limit: 4 **inches** for concrete, plus or minus **1 inch**.
4. Air Content: **6 percent**, plus or minus 1 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 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.

C. Insert spacing of contraction joints here or on Drawings if required. Contraction-joint spacings vary with slab thickness, aggregate size, and slump based on PCA's recommendations. Depth of joint may be varied to suit cutting method or if steel-fiber reinforcement is used. Early-entry saws may cut less than one-fourth of concrete thickness; steel-fiber-reinforced slabs, one-third of concrete thickness.

D. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated, with a maximum joint spacing of 36 times slab thickness at any area. Construct contraction joints for a depth equal to at least 1/4 of concrete thickness as follows (unless indicated otherwise):

E. 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.

3.2 CONCRETE PLACEMENT

A. Pre-placement Inspection: Before placing concrete, inspect and complete formwork installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms and base materials immediately before placing concrete where form coatings are not used.

B. Bring slab surfaces to correct level with straightedge and strikeoff highway straightedge at all flatwork with tolerance of F 20 or less. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations. Laser screeds may be required for placement in areas where flatness specifications are greater.

C. Cold-Weather Placement: Comply with ACI 306.1 and as herein specified.

D. Hot-Weather Placement: Comply with ACI 301 and as herein specified.

E. Hot Weather Placement: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.

F. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.

G. Fog spray forms, reinforcing steel and subgrade just before concrete is placed. During and after placement, provide fog spray over, but not directly on concrete.

H. Concrete shall not be retempered. Discard concrete that has obtained its initial set.

I. Site water shall not be added. If workability is desired, add superplasticizer on site as specified.

J. Use water-reducing retarding admixture (Type D) when required by high temperatures, low humidity, or other adverse placing conditions.

S. Cool ingredients before mixing to maintain concrete temperature at time of placement. Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.

T. Cold Weather Placement: Comply with ACI 306. When air temperature is expected to fall below 40 degrees, uniformly heat all mixing ingredients. Provide protection as required when overnight temperatures are expected to drop below 34 degrees. Do not use any materials that are frozen. Cover slabs and exposed concrete as required through below freezing temperatures at all times. If temperatures drop below 26 degrees, reschedule placement until weather permits.

U. Concrete shall be in mixer no more than the maximum specified. Trucks shall be ordered to return to the plant, with the load rejected if concrete exceeds this condition.

3.3 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. 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 ten[1] days.

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 ten[1] days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

    a. Moisture Retaining Fabric shall be installed in accordance with manufacture’s written recommendations, in largest practical widths. Wet the slab to rejection then thoroughly wet fabric side of cover and install with poly side up. Lap over adjacent covers a minimum 18”. Weight all laps and outside edges to prevent displacement and to ensure intimate contact with concrete and adjacent covers. Rewet as necessary and protect covers from damage during curing process.[1]

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 **unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project**.

4. Coating, 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.[1]

3.4 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.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner shall pay for sampling and testing for quality control during placement of concrete and masonry grout shall include the following, as directed by Architect.

B. Sampling Fresh Concrete: ASTM C 172, except modified for slump to comply with ASTM C 94.

C. Slump: ASTM C 143; one test at point of discharge for each truck. Test shall be at the initial pour and middle of pour.

D. Air Content: ASTM C 173, volumetric method for normal weight concrete; ASTM C 231 pressure method for normal weight concrete; as applicable, one for each day's pour of each type of air entrained concrete.

E. Compression Test Specimen: ASTM C 31; one set of 4 standard cylinders (3 to be used and one for reserve) for each compressive strength test, at 7 / 28 days, unless otherwise directed. Mold and store cylinders for laboratory cured test specimens except when field-cure test specimens are required. Frequency of testing shall comply with ACI 318. Record temperature each time a set of compression test specimens are made.

F. Test results will be reported in writing to Architect and Contractor on same day that tests are made. Reports of compressive strength tests shall contain the project identification name and number, date of concrete placement, name of concrete testing service, concrete type and class, location of concrete batch in structure, design compressive strength at 28 days, concrete mix proportions and materials; compressive breaking strength and type of break for both 7-day tests and 28-day tests.

G. Testing Engineer or job superintendent shall reject the load if slump, water/cement ratio, air content or related specified requirements are not met. Notify Architect immediately of such conditions.

H. Additional Tests: Contractor shall pay for such tests conducted, and any other additional testing as may be required, when unacceptable concrete is verified.

END OF SECTION 32 13 10

SECTION 32 17 13 – PLASTIC BOLLARD COVERS

PART 1 - GENERAL

1.1 CONDITIONS OF THE CONTRACT:

A. Conditions of the Contract, DIVISION 00 and General Requirements, DIVISION 01 govern work under this Section.

1. Performance of the Work of this Section shall comply with Division 00 Prevailing Wage Rate Requirements that apply to this project.

1.2 DESCRIPTION OF WORK:

A. Section includes furnishing and installing plastic (polyethylene) bollard covers as indicated on drawings, and specified herein.

B. Refer to drawings for locations and quantities.

1.3 SUBMITTALS:

A. Product Data: Submit product data for each product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Provide bollard covers from one of the following manufacturers:

1. EnDafeCo
2. Ideal Shield
3. Post Guard
4. Approved equal

2.2 MATERIALS:

A. General: Provide high density polyethylene bollard cover complying with the following:

1. Wall thickness: .125”
2. Flexural strength: 200,000 psi
3. Tensile strength: 4,000 psi
4. UV protection: UV stabilization package warranted for a minimum of five years.
5. Color: yellow.
6. Tops shall be rounded.
7. Other: Abrasion and environmental stress crack resistant

B. Sizes: Refer to the drawings for locations and sizes of steel bollards. Over size sleeves to allow for fitting, cutting and slope at grade.

C. Sizes:
1. Standard bollard covers: 4’ + in height (refer to drawings for height of bollards.)

D. Accessories: Provide foam strips as recommended by the manufacturer for a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION:

A. Install items included in this section in locations indicated on the drawings. Follow the manufacturer's instructions on installation and adjustment.

B. Secure units and trim with foam strips as required.

C. Clean and protect units upon completion.

END OF SECTION 31 17 13

ThreeRivers PARK DISTRICT in partnership with Scott County

CLEARY LAKE
MAINTENANCE BUILDING

At

Cleary Lake Regional Park
6246 190th St. E., Prior Lake, MN 55372

Issued July 25, 2019

PROJECT MANUAL

Book 2 of 2

SCOTT COUNTY
GOVERNMENT CENTER
200 4TH AVE W.
SHAKOPEE, MN 55379

CLE 1901

MECHANICAL TABLE OF CONTENTS

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SECTION 22 05 00

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. Coordination
2. Interpretation of Plans
3. Coordination Drawings.
4. Cost Breakdown
5. Substitutions and Prior Approval Requests
6. Record Documents
7. Maintenance Manuals
8. Fire Safety Precautions
9. Personal Safety Requirements
10. Testing, Adjusting and Balancing
11. Equipment Rebates
12. Renovation Projects
13. Temporary Equipment Operation
14. Piping materials and installation instructions common to most piping systems.
15. Plumbing demolition.
16. Equipment installation requirements common to equipment sections.
17. Painting and finishing.
18. Concrete bases.
19. Supports and anchorages.

1.03 GENERAL

A. This Section includes mechanical items common to all of this division specification sections.

B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.

C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.

D. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

1.04 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheat-

ed spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. ABS: Acrylonitrile-butadiene-styrene plastic.
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

1.05 WARRANTY

A. Provide guarantee and maintain the stability of workmanship and materials used and keep same in good operating condition for a period of minimum or one year after final completion of the work (unless specified otherwise) as evidenced by the issuance of the final certificate by the Architect.

B. Correct any deficiencies/defects of any kind immediately and; at the Contractors expense due to faulty workmanship or materials that arise during the above mentioned period of time. Corrections shall be done to the satisfaction of the Engineer/Architect. Such reconstruction and/or repairs shall include damages to the finishes or the building resulting from the original defect.

1.06 COORDINATION

A. Coordinate mechanical work with that of other trades in order to:

1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.
2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.
3. Indicate aisle-ways and access-ways required on coordinated shop drawings for roof equipment area, mechanical equipment rooms, data and telecomm rooms, corridors, ceiling spaces, shafts, corridors, ceiling space, laboratories, etc.

B. Understanding of Work:

1. Study, examine, and compare of the contract documents, including drawings and specifications. The Subcontractor shall have a full understanding of how the work in this part is scheduled, phased, and installed with work of other trades.
2. Include in this installation piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.
3. Connect piping and ductwork from fixtures, outlets, and devices full size to the nearest suitable main or riser.

4. Certain installations may be presented as typical, and full details are not repeated for each case. Subcontractor shall provide complete installation as if full details apply to each and every case, and make adjustments to typical details to suit each specific installation as part of the basic work.
5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.
6. If there is a discrepancy in the drawings or specifications, the contractor shall figure the work based on the most stringent requirements to complete the installation and obtain clarification from the Architect before installation.

C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Work shall be above ceilings or ceiling line.
7. Coordinate installation and connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The contractor is responsible for required piping and ductwork offsets to insure that the panels are located as designed and for other conditions.
13. Perform system modification recommended by Test and Balance Agency after recommendations are accepted by the Engineer

1.07 INTERPRETATION OF PLANS

A. In general, the Drawings are to scale. However, to determine exact locations of walls and partitions, the Contractor shall consult the architectural and/or structural Drawings which are dimensioned. Drawings shall not take precedence over field measurements.

B. Drawings are diagrammatic only. They are intended to indicate size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail of construction. All work shall be constructed from field measurements taken at the site. This shall include all rises, drops, elbows, offsets, etc as necessary to avoid structural members or equipment and materials installed by other trades. The contractor shall coordinate the ductwork and piping layout before construction. No additional costs will be allowed for piping and ductwork fabrications without field verification of available space. If it is found, before installation, that a more convenient, suitable or workable arrangement of any or all phases of construction would result by altering the arrangement indicated on the Drawings, the architect/engineer may require the contractor to change the arrangement of his work without additional cost to the owner.

C. The drawings and specifications are intended to supplement each other. Any items shown on the drawings and not mentioned in the specifications, or vice versa, shall be executed the same as if mentioned and shown.

D. The greatest quantity or more expensive work shall govern where there is a conflict noted anywhere on the drawings and/or specifications.

1.08 COST BREAKDOWN

A. Submit a cost breakdown for each claim according to General Conditions of the Contract. Include project name, location, Architect/Engineer, Contractor and date.

1. List the cost breakdown for labor and material separately and include a total.

2. Breakout and detail the cost according to specification sections.

1.09 SUBSTITUTIONS AND PRIOR APPROVAL REQUESTS

A. Equipment manufacturers where indicated on the drawings are the basis of design. The contractor accepts responsibility for all design implications when providing approved equipment other than the design basis.

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics than the basis of design may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at the cost of the contractor. If minimum energy rating or efficiencies are specified, equipment shall comply with those requirements. Cost implications to other trades are the responsibility of the contractor.

C. Dimensional and Wight Changes: Substituted equipment with dimensions or weight different than the basis of design may be furnished provided such proposed equipment is approved in writing. The contractor is responsible for verifying and coordinating proposed equipment such that it maintains the design intent for access and serviceability and reserves space for future equipment where required. Cost implications to other trades are the responsibility of the contractor.

D. Bids shall be based on the exact materials specified, those listed scheduled on the drawings, or on materials which have been accepted as equivalent. The specified/scheduled products have been used in the design of the project and the preparation of the drawings and specifications as such establish minimum standards of function, dimension, appearance and quality necessary and requisite for this project, which substitutes must meet to be considered acceptable. The burden of proof of equality rests with the party making the request.

E. Requests for substitution shall be in writing and shall be received by the Engineer not later than 10 days before bid opening date. Materials not specified or accepted as equivalent shall not be acceptable for installation.

F. Each prior approval request for substitution shall include and meet the following requirements:

1. The name and model of the material or equipment for which an equivalent is being proposed and a complete description of the proposed equivalent including drawings, cuts sheets, equipment performance capacity and test data, equipment weights, electrical and any other information necessary for a complete evaluation.

2. A written comparison listing any deviations from the scheduled equipment and/or the specification requirements must also be provided prior to any proposed substitution will be evaluated.

3. A written statement setting forth any changes in other materials, equipment, electrical, structural and/or other Work in which incorporation of the equivalent may be required shall be included.

4. Material and/or equipment requests which do not meet the above requirements will not be evaluated or approved.

5. The burden of proof of the merit of the proposed equivalent is upon the proposer. Any and all extra costs associated with the equipment change and affecting architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the entity requesting the substitution.

6. The Engineer's decision of approval or disapproval of a proposed equivalent is final.

G. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as scheduled and acceptable installation. General approval to bid a product does not relieve the Supplier or Contractor of meeting specific specification requirements.

H. The Mechanical Contractor shall pay, provide, install and be responsible for extra materials required or any other trade due to this use of alternate accepted equipment which has installation requirements different than the specified equipment. The Mechanical Contractor shall pay other trades for any extra work they are involved in due to this substitution of equipment.

I. If substitutions of controls or equipment require any changes in the architectural, structural, mechanical, plumbing or electrical work from that shown on the drawings, the extra cost of the equipment or architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the Contractor requesting the substitution. All substitutions shall be prior approved by the Architect or Engineer before purchase by the contractor.

J. Where any redesign of electrical, mechanical or other work is required due to substitution, arrangement or equipment layout other than herein specified or shown:

1. Arrange for required redesign by Architect and Engineer.
2. Pay all costs for such redesign.

1.010 SUBMITTALS

A. Refer to individual product and equipment specification sections for detailed submittal requirements.

B. The mechanical and electrical contractor shall have an onsite meeting prior to installation to review all shop drawings and verify all electrical requirements with the electrical contractor. The mechanical contractor shall be responsible for coordinating and setting up meeting and sharing of mechanical equipment electrical requirements with electrical contractor prior to when construction is set to begin and equipment is to be ordered.

C. The electrical contractor shall sign off on all mechanical shop drawings for electrical requirements prior to ordering equipment.

1.011 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "Project Record Documents." In addition to the requirements specified in Division 1, at a minimum the contractors shall:

1. Maintain an on-site set of drawings to record actual revisions to the work being performed on site. Revisions shall be shown on the documents legibly to reflect actual on-site changes to the documents.
2. Revisions shall be show on the documents in a contrasting color (red).
3. Revisions shall be updated to the on-site plan daily.
4. Ensure all revisions and documentation is complete and accurate, enabling future reference by Owner.

B. Refer to specific sections for additional record documentation.

1.012 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 Section "Operating, Maintenance, and Warranty Data". Submit copies for review by Architect/Engineer. In addition to the requirements specified in Division 1, include the following information:

1. Descriptive summary of function, normal system operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Warranty information for all mechanical items shall be included in one tabbed section.

1.013 FIRE SAFETY PRECAUTIONS

A. The Contractors shall exercise extreme care to maintain and exercise adequate fire safety precautions throughout the work. This shall include providing sufficient fire fighting devices, watchmen, standby helpers or other precautions during construction, in use of temporary heat, welding, brazing, sweating, testing or other phases of work.

B. At all times, access shall be maintained for fire department trucks to the building.

C. All welding brazing, cutting and sweating operations performed in vicinity of or accessible to combustible materials shall be adequately protected to make certain that sparks or hot slag does not reach the combustible material and start a fire.

D. All glass, glazed materials and other finish, in the vicinity of welding, brazing and cutting, shall be masked by the Contractor performing the welding work.

E. When necessary to do cutting, welding, brazing, sweating and similar work in vicinity of wood, in shafts, or vicinity of any combustible material (and the combustible material cannot be removed), the materials shall be adequately protected with fire resistant blankets or similar approved coverings. In addition, a helper shall be stationed nearby with proper fire extinguishers (provided by the Contractor performing the work) to guard against sparks and fire.

F. Whenever combustible materials have been exposed to sparks, molten metal, hot slag or splatter, a person shall be kept at the place of work to make sure the smoldering fires have not been started. Whenever cutting or welding operations are carried on in a vertical pipe shaft, a person to act as a fireguard shall be employed to examine all floors below the point of cutting or welding. This fireguard shall be kept on duty after completion of work to guard against fires and shall examine each level after this time, prior to leaving. There shall be no exceptions to this requirement and failure to comply will be construed as negligence.

1.014 EQUIPMENT REBATES

A. The contractor shall be responsible for applying for and leading the rebate application process for all eligible equipment / systems within the project on behalf of the owner.

B. The contractor shall provide all receipts, invoicing, counts, site data, etc as required to procure equipment rebates

C. The contractor shall forward the filled out application and all necessary rebate “back-up” requirements to the owner at the completion of the project.

1.015 PERSONAL SAFETY REQUIREMENTS

A. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions required in connection with his work, including regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

1.016 TESTING, ADJUSTING AND BALANCING

A. All domestic hot water circulation systems will be balanced by an independent test and balance agency hired by the mechanical contractor. The scope of the testing and balancing work includes functional performance testing of all mechanical systems. Deficiency reports will be distributed directly to the contractor on an ongoing basis. Exceptions taken to specific direction issued by the testing agency shall be brought to the attention of the engineer by the installing contractor.

B. The Contractor shall be certain that all systems are ready for proper operation prior to balancing and adjusting with clean filter and other system elements, e.g., coils. Temperature control calibration, electrical interface, etc., shall also be complete prior to balancing and adjusting. All equipment shall be freshly oiled. The Contractor shall instruct his employees and subcontractors to leave all balancing devices in a wide open position and free all operating arms and adjustments so that they can be easily operated. The contractor shall write a letter to the testing agency indicating that each of the areas defined by the construction schedule is complete and ready for balancing.

C. The Contractor shall provide and coordinate the services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.

D. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate the systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB.

E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.

F. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB Firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

1.017 TEMPORARY HEAT/EQUIPMENT OPERATION

A. Provide temporary gas meter and connections to equipment provided by the General Contractor as required for temporary heat.

B. Warranties:

1. The Contractor shall provide extended warranties for all equipment and mechanical system components operated prior to the date of substantial completion. The Contractor shall obtain in writing from the manufacturer extended warranties for all equipment such that the Owner's warranty starts at the date of substantial completion in accordance with the General Division 1 requirements. Any additional costs shall be the burden of the Contractor.

PART 2: PRODUCTS

2.01 SUBMITTALS

A. Submit product data for the following in accordance with requirements of Division 1 Specification Section 01300, “Submittals.”

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

2.02 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 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. Required electrical modifications must be approved by the Electrical Engineer and be provided at no additional cost to the Owner. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

2.03 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.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

C. Storage of materials and equipment shall not impede the work of other contracts.

D. Handling of equipment and products shall be according to manufacturers instructions and in compliance with the articles of their warranty.

E. Protect products from weather, unless product is slated for exterior installation. If outdoor storage is necessary, support products off the ground or pavement in watertight enclosures.

2.04 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."

2.05 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 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.

2.06 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.07 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Plastic-to-Metal Transition Fittings: One-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. 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.

2.08 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.09 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.010 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.011 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. Provide with polished chrome plated finish.

2.012 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 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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.

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 fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors:

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:

1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.

2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.

3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.

4. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.

5. PVC Nonpressure Piping: Join according to ASTM D 2855.

6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.

1. Plain-End Pipe and Fittings: Use butt fusion.

2. Plain-End Pipe and Socket Fittings: Use socket fusion.

M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 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.

3.05 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.

3.06 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.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.08 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.09 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 22 05 00

SECTION 22 05 19

METERS AND GAGES FOR PLUMBING PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Division 22 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.

2. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.03 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type of product indicated; include performance curves.

C. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

PART 2: PRODUCTS

2.01 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 7 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.02 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Liquid-filled type, drawn steel or cast aluminum 5” diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass.

H. Ring: Brass is unfinished areas including mechanical rooms; stainless steel in finished areas.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.04 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following.

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram.
3. Palmer - Wahl Instruments Inc.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type drawn steel or cast aluminum 2" diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Brass in unfinished areas including mechanical rooms; stainless steel in finished areas.
9. Accuracy: Grade B, plus or minus 2 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Drawn steel or cast aluminum, 4½" diameter with holes for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Brass in unfinished areas including mechanical rooms; stainless steel in finished areas.
9. Accuracy: Grade B, plus or minus 2 percent of middle half.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.05 TEST PLUGS

A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

C. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for water service at 20 to 200 deg F shall be CR.

2. Insert material for water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3: EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install thermometers in the outlet of each domestic, hot-water storage tank where indicated.

B. Provide the following temperature ranges for thermometers:

1. Domestic Hot Water: 30 to 240 deg F with 2-degree scale divisions.

2. Domestic Cold Water: 0 to 100 deg F with 2-degree scale divisions.

3.02 GAGE APPLICATIONS

A. Install pressure gage at water service entrance at inlet and discharge of each pressure reducing valve, and as indicated.

B. Pressure gage ranges shall be twice the normal operating pressure.

3.03 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install remote-mounting pressure gages on panel.

F. Install needle-valve and snubber fitting in piping for each pressure gage.

G. Install test plugs in tees in piping.

H. Install permanent indicators on walls or brackets in accessible and readable positions.

I. Install connection fittings for attachment to portable indicators in accessible locations.

J. Install thermometers and gages adjacent to machines and equipment to allow service and maintenance for thermometers, gages, machines, and equipment.

K. Adjust faces of thermometers and gages to proper angle for best visibility.

END OF SECTION 22 05 19

SECTION 22 05 23

GENERAL-DUTY VALVES FOR PLUMBING PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Bronze gate valves.
7. Iron gate valves.
8. Bronze globe valves.

B. Related Sections:

1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.

2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

3. Division 33 water distribution piping Sections for general-duty and specialty valves for site construction piping.

1.03 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Nonrising stem.

E. OS&Y: Outside screw and yoke.

F. RS: Rising stem.

G. SWP: Steam working pressure.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type of valve indicated.

1.05 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.

2. ASME B31.1 for power piping valves.

3. ASME B31.9 for building services piping valves.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. Lead Free Requirements: All plumbing pipes, fittings, valves, fixtures, and other components in systems providing water for human consumption shall be 'lead-free' in accordance with the "Reduction of Lead in Drinking Water Act" and the "Safe Drinking Water Act", where the term 'lead-free' is defined to mean – "not containing more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures."

1.06 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.

2. Protect threads, flange faces, grooves, and weld ends.

3. Set angle, gate, and globe valves closed to prevent rattling.

4. Set ball and plug valves open to minimize exposure of functional surfaces.

5. Set butterfly valves closed or slightly open.

6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.

2. Handwheel: For valves other than quarter-turn types.

3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.

4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.

e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.03 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hammond Valve.
b. Milwaukee Valve Company.
c. NIBCO INC.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 200 psig.
c. Body Design: Vertical flow.
d. Body Material: ASTM B 61 or ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: NBR, PTFE, or TFE.

2.04 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 300 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

2.05 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kitz Corporation.
b. Milwaukee Valve Company.
c. Powell Valves.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.06 IRON GATE VALVES

A. Class 125, NRS, Iron Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-70, Type I.
b. CWP Rating: 200 psig.
c. Body Material: ASTM A 126, gray iron with bolted bonnet.
d. Ends: Flanged.
e. Trim: Bronze.
f. Disc: Solid wedge.
g. Packing and Gasket: Asbestos free.

2.7 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Powell Valves.
f. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Provide ball valve type isolation shutoff valve at all branch water lines serving each toilet room group. Locate shutoff valve outside of toilet room area and within an accessible space.

D. Provide all domestic water branches containing 3 or more fixtures with an isolation valve.

E. Provide all individual fixtures with an isolation valve.

F. Provide ball valve type isolation shutoff valve at all branch supply and return lines where the piping branches are taken from another piping main whether specifically shown on the plans or not and as required for balancing and system isolation. Provide whether specifically shown on the plans or not.

G. Provide shutoff valves located in new and or existing piping system as required to isolate areas/systems to all for demolition and installation of new system where required to maintain operation of existing areas.

H. Install valves in horizontal piping with stem at or above center of pipe.

I. Install valves in position to allow full stem movement.

J. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

2. Lift Check Valves: With stem upright and plumb.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly, or gate valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service: Globe or ball valves.

4. Pump-Discharge Check Valves:

a. NPS 2 and Smaller: Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded or solder ends.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.

3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

3.05 LOW-PRESSURE, COMPRESSED-AIR VALVE APPLICATION 150 PSIG OR LESS

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

3. Bronze Lift Check Valves: Class 125, bronze disc.

4. Bronze Swing Check Valves: Class 125, bronze disc.

3.06 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint or threaded ends.

2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.

3. Bronze Swing Check Valves: Class 150, bronze disc.

4. Bronze Gate Valves: Class 150, NRS.

5. Bronze Globe Valves: Class 150, nonmetallic disc.

B. Pipe NPS 2-1/2 to NPS 4:

1. Iron Valves: May be provided with threaded ends or flanged ends.

2. Iron Ball Valves: Class 150

C. Pipe NPS 5 and Larger:

1. Iron Ball Valves: Class 150.

2. Iron, Single-Flange Butterfly Valves: 200 CWP, EPDM, aluminum, bronze disc.

END OF SECTION 22 05 23

SECTION 22 05 29

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

2. Division 21 Section "Water-Based Fire-Suppression Systems" for pipe hangers for fire-suppression piping.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.04 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.05 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For the following:

1. Steel pipe hangers and supports.

2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.
4. Pipe positioning systems.

C. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Pipe stands. Include Product Data for components.
4. Equipment supports.

D. Welding certificates.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."

PART 2: PRODUCTS

2.01 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.04 INSULATION INSERT

A. Description: 100-psig minimum, compressive-strength insulation insert.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

D. For Trapeze or Clamped Systems: Insulation insert shall cover the entire point of contact with the pipe hanger or bracket.

E. For Clevis or Band Hangers: Insulation insert shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 INSULATION SHIELD

A. Description: 16 gauge galvanized sheet metal formed to fit contour of pipe insulation.

B. Shield Length: Minimum 12".

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.07 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Base: Stainless steel.

2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Bases: One or more plastic.

2. Vertical Members: Two or more protective-coated-steel channels.

3. Horizontal Member: Protective-coated-steel channel.

4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.08 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

2.09 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.10 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3: EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. All piping hangers, saddles and all associated rods, clips, bolts, supports, shields, straps and building attachments shall be stainless steel where located in wash bay, wash bay equipment or chemical storage rooms.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.

3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.

6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.

10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

13. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

15. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Insulation Insert Installation: Install in pipe hanger for all insulated piping 2” and larger.

E. Insulation Shield: Install insulation shields at all hanger locations for insulated piping.

F. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

G. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

H. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above or below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

   b. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
   d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
   e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.

6. Insert Material: Length at least as long as protective shield.

7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up: 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.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 05 29

SECTION 22 05 53

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.03 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type of product indicated.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme.

F. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2: PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel, rivets or self-tapping screws.

5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.

3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F (71 deg C).

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch (A4) bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

2.04 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032-inch or stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link, beaded chain, or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch (A4) bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.05 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.

2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."

4. Color: Yellow background with black lettering.

PART 3: EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.03 PIPE LABEL INSTALLATION

A. Piping Color-Coding: Painting of piping is specified in Division 09 Section “Interior Painting.”

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; inside of sink cabinets; machine rooms; accessible maintenance spaces such as shafts, tunnels, under cabinets and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. At each side of penetrations through all walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

8. Where major devices, valves, dampers, etc are above ceiling, provide equipment identification on ceiling grid to assist in locating device. Include direction arrow to identify specific tile.

C. Pipe Label Color Schedule:

1. Low-Pressure, Compressed-Air Piping:

   a. Background Color: Blue.
   b. Letter Color: White.

2. Domestic Water Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3. Sanitary Waste and Storm Drainage Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3.04 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

   a. Cold Water: 1-1/2 inches, round.
   b. Hot Water: 1-1/2 inches, round.
   c. Low-Pressure Compressed Air: 1-1/2 inches

2. Valve-Tag Color:

   a. Cold Water: Natural.
   b. Hot Water: Natural.
   c. Low-Pressure Compressed Air: Natural.

3. Letter Color:

   a. Cold Water: Black.
   b. Hot Water: Black.
   c. Low-Pressure Compressed Air: Black.

3.05 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 22 05 53

SECTION 22 07 00

PLUMBING INSULATION

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. Insulation Materials:

    a. Flexible elastomeric
    b. Mineral fiber
    c. Polyolefin

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied jackets.
9. Tapes.
10. Securements.
11. Corner angles.

B. Related Sections include the following:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 23 Section "HVAC Insulation."

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.06 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.07 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2: PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric (FE): Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials; thermal conductivity (avg) of 0.27 Btu/hr-ft^2-°F or lower at mean temperature of 75°F; 3.0 lbs./ft^3 density (ASTM D/622); 0.08 perm-in permeability (ASTM E96); 0.2% water absorption (ASTM C209).

G. Mineral-Fiber Blanket Insulation (MF): Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I; thermal conductivity (avg) of 0.25 Btu/hr-ft^2-°F or lower at mean temperature of 75°F. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

H. Mineral-Fiber, Preformed Pipe Insulation (MF): Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL; thermal conductivity (avg) of 0.25 Btu/hr-ft^2-°F or lower at mean temperature of 75°F. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.

I. Mineral-Fiber, Pipe and Tank Insulation (MF): Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 3.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

J. Polyolefin (P): Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials; thermal conductivity (avg) of 0.25 Btu/hr-ft^2-0F or lower at mean temperature of 75°F; 1.5 lbs./ft^3 density (ASTM D1622); 0.0 perm-in permeability (ASTM E96); 0.0% water absorption (ASTM C209).

2.02 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
2. Service Temperature Range: Minus 20 to plus 180 deg F.
3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
2. Service Temperature Range: Minus 20 to plus 200 deg F.
3. Solids Content: 63 percent by volume and 73 percent by weight.
4. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.

2. Service Temperature Range: Minus 50 to plus 180 deg F.

3. Color: White.

2.06 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.
2. Fire- and water-resistant, flexible, elastomeric sealant.
3. Service Temperature Range: Minus 40 to plus 250 deg F.
4. Color: White.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, as follows:

1. Shall comply with ASTM C921, Type I, for applications where the equipment or pipes operate below ambient temperature at least part of the time or where a vapor barrier is required.

2. Shall comply with ASTM C921, Type II, for applications where equipment or pipes operate above ambient temperatures or where a vapor retarder is not required.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; roll stock ready for shop or field cutting and forming. Minimum 30ml thickness.

1. Adhesive: As recommended by jacket material manufacturer.

2. Color: White.

3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

C. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

   a. Factory cut and rolled to size.

   b. Finish and thickness are indicated in field-applied jacket applications.

   c. Moisture Barrier for Outdoor Applications: 2.5-mil thick Polysurlyn.

   d. Factory-Fabricated Fitting Covers:

      1) Same material, finish, and thickness as jacket.
      2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      3) Tee covers.
      4) Flange and union covers.
      5) End caps.
      6) Beveled collars.
      7) Valve covers.
      8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 11.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.
2. Thickness: 6.5 mils.
3. Adhesion: 90 ounces force/inch in width.
4. Elongation: 2 percent.
5. Tensile Strength: 40 lbf/inch in width.
6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.

2. Thickness: 6 mils.
3. Adhesion: 64 ounces force/inch in width.
4. Elongation: 500 percent.
5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 0.015 inch thick, 1/2 inch wide with wing seal.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.

c. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.03 PIPING INSULATION APPLICATION

A. Indoor Piping System Insulation: Insulate with insulation types and thickness as listed in Table below. If more than one pipe material is listed for a piping system, selection from materials listed is the contractor's option.

1. Potable cold water, hot water, and hot water circulating piping.
2. Interior aboveground, horizontal and vertical storm water piping. Storm water piping includes all drawings connected to both primary and overflow roof drains including drain bodies.
3. Plumbing vents within 20 lineal feet of roof outlet.
4. Condensate drain piping from cooling coils.
5. Make-up water piping to HVAC equipment and systems.
6. P-trap and 5 lineal feet of sanitary piping from AHU condensate drains.

TABLE NO. 22 07 00-1: MINIMUM PIPE INSULATION

PIPING SYSTEM	TYPE OF (1) INSULATION	1¼" & SMALLER	1½" TO 2"	2½" & LARGER
Cold Water Piping	MF, FE	½"	1"	1"
HW Piping	MF	1"	1½"	1½"
HW Circulating Piping	MF	1"	1½"	1½"
Plumbing Vents	MF, FE	½"	1"	1"
Condensate Drains	FE, P	½"	1"	1"
Make-up Water Piping	MF,FE	½"	1"	1"
Hot Drain Piping	MF	½"	1"	1"
P-Trap and Sanitary Piping	MF, FE	½"	1"	1"

NOTES:

1. Insulation material abbreviations:
   a. Mineral Fiber (MF)
   b. Flexible Elastomeric (FE)
   c. Polyolefin (P)

B. Refer to Division 23 Section 22 05 29 “Hangers and Supports for Piping and Equipment” for insulation insert and insulation shield requirements.

C. Provide insulation kit equal to Truebro Inc. model # 102 Handi-Lav Guard insulation for all exposed hot and cold water and waste piping and fittings.

D. Outdoor Piping System Insulation: Increase insulation thicknesses indicated for indoor applications by ½”. All outdoor insulation shall be mineral fiber or polyolefin. Provide with weather barrier aluminum jacket.

E. All exposed indoor piping insulation shall be covered with a field installed paintable PVC jacket.

F. Insulation Omitted: Omit insulation for the following:

1. Interior air conditioner condensate drain piping in mechanical rooms provided piping is less than 3 lineal feet and is located within 12” of floor.

2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.04 EQUIPMENT INSULATION APPLICATIONS

A. Insulation materials and thicknesses are identified within this specification section. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Domestic hot-water storage tank insulation shall be one of the following:

1. Mineral-Fiber Board: 4 inches thick and 3-lb/cu. ft. nominal density.

2. Mineral-Fiber Pipe and Tank: 4 inches thick.

3.05 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.06 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
   1. Seal penetrations with flashing sealant.

   2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

   3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

   4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

   1. Seal penetrations with flashing sealant.

   2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

   3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

   4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

   1. Comply with requirements in Division 07 Section "Penetration Firestopping"irestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

   1. Pipe: Install insulation continuously through floor penetrations.

   2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.07 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

   2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.

   3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

   a. Do not weld anchor pins to ASME-labeled pressure vessels.

   b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.

   c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.

   d. Do not overcompress insulation during installation.

   e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

   f. Impale insulation over anchor pins and attach speed washers.

   g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.08 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

    a. Fiberglass inserts with a thickness and density equal to the adjacent pipe insulation with a pre-formed PVC fitting cover may be used in lieu of preformed or mitered fitting covers.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Provide 16 gauge galvanized sheet metal insulation shields at all hanger locations. Shields shall be a minimum 12” in length and formed to fit pipe contour.

3.09 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

3.11 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.12 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

END OF SECTION 22 07 00

SECTION 22 11 16

DOMESTIC WATER PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. Section Includes:

1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
2. Encasement for piping.
3. Specialty valves.
4. Flexible connectors.
5. Waer meters furnished by utility company for installation by Contractor.
6. Water meters.
7. Escutcheons.
8. Sleeves and sleeve seals.
9. Wall penetration systems.

1.03 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For the following products:

1. Specialty valves.
2. Dielectric fittings.
3. Flexible connectors.

C. Coordination Drawings: Refer to coordination drawing requirements of 22 05 00.

D. Field quality-control and test and inspection reports.

1.04 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

PART 2: PRODUCTS

2.01 PIPING MATERIALS

A. Comply with requirements in "Piping Applications" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.

2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

3. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

4. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

5. Copper-Tube Extruded-Tee Connections: ASTM F 2014.

B. Soft Copper Tube: ASTM B 88, Type K water tube, annealed temper. Copper Solder-Joint Fittings complying with ASME B16.22, wrought-copper pressure fittings.

2.03 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated.

1. Standard-Pattern, Push-on-Joint Fittings: AWWA C110, ductile or gray iron.

a. Gaskets: AWWA C111, rubber.

2.04 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

2.05 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

2.06 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

D. Plastic-to-Metal Transition Fittings: CPVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert and one solvent-cement-socket or threaded end.

E. Plastic-to-Metal Transition Unions: CPVC four-part union. Include brass threaded end, solvent-cement-joint or threaded plastic end, rubber O-ring, and union nut.

2.07 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: 150 psig at 180 degrees F., solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges: Factory-fabricated, bolted, companion-flange assembly. Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits: 150 psig rated, non-conducting materials for field assembly.

1. Gasket: Neoprene or phenolic.
2. Bolt Sleeves: Phenolic or polyethylene.
3. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings: 300 psig at 225 degrees F., galvanized steel coupling.

1. End Connections: Female threaded.
2. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples: ASTM F1545, 300 psig at 225 degrees F., electroplated steel nipple.

1. End Connections: Male threaded.
2. Lining: Inert and noncorrosive, propylene.

2.08 FLEXIBLE CONNECTORS

A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.

1. Working-Pressure Rating: Minimum 200 psig.
2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.

2.09 WATER METERS

A. Turbine-Type Water Meters:

1. Description:

a. Standard: AWWA C701.
b. Pressure Rating: 150-psig working pressure.

c. Body Design: Turbine; totalization meter.
d. Registration: In gallons or cubic feet as required by utility company.
e. Case: Bronze.
f. End Connections for Meters NPS 2 and Smaller: Threaded.
g. End Connections for Meters NPS 2-1/2 and Larger: Flanged.

2.10 ESCUTCHEONS

A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.

B. One Piece, Cast Brass: Polished, chrome-plated finish with setscrews.

C. One Piece, Deep Pattern: Deep-drawn, box-shaped brass with chrome-plated finish.

D. Split Casting, Cast Brass: Polished, chrome-plated finish with concealed hinge and setscrew.

E. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

F. Split-Casting Floor Plates: Cast brass with concealed hinge.

2.11 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.12 SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

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: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.13 GROUT

A. Standard: ASTM C 1107, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3: EXECUTION

3.01 PIPING APPLICATIONS

A. Above Ground: Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 4 inches and smaller. Install Type L, drawn copper tube with brazed joints for pipe sizes 5 inches and larger.

B. Under Building Slab: Install Type K, annealed temper copper tube for pipe sizes 2 inches and smaller. Do not install with joints below ground.

C. Below Ground Water Service Pipe: Push-on-joint, ductile-iron pipe; standard pattern mechanical joint fittings and mechanical joints.

D. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

E. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

3.02 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. 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.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Brazed Joints" Chapter.

E. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

F. Ductile-Iron-Piping Grooved Joints: Cut groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join ductile-iron pipe and grooved-end fittings according to AWWA C606 for ductile-iron-pipe, cut-grooved joints.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.03 VALVE APPLICATIONS

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.

2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with

flanged ends for piping NPS 2-1/2 and larger.

3. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

3.04 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.

D. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

E. Install shutoff valve immediately upstream of each dielectric fitting.

F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

G. Install domestic water piping level and plumb.

H. The mechanical contractor shall provide the local utility with water flow requirements and coordinate sizing per the local utility. Install water-meter installation according to utility company's requirements.

I. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

J. 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.

K. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

L. Install piping adjacent to equipment and specialties to allow service and maintenance.

M. Install piping to permit valve servicing.

N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

O. Install piping free of sags and bends.

P. Install fittings for changes in direction and branch connections.

Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

R. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

3.05 VALVE INSTALLATION

A. Refer to section 22 05 23 for additional valving requirements.

B. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

C. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball or gate valves for piping NPS 2 and smaller. Use butterfly or gate valves for piping NPS 2-1/2 and larger.

D. Provide ball valve type isolation shutoff valve at all branch supply and return lines where the piping branches are taken from another piping main whether specifically shown on the plans or not and as required for balancing and system isolation. Provide whether specifically shown on the plans or not.

E. Provide shutoff valves located in new and or existing piping system as required to isolate areas/systems to all for demolition and installation of new system where required to maintain operation of existing areas.

F. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."

1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

3.06 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. NPS 1-1/2 and Smaller: Fitting-type coupling.
2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.07 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings or nipples.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.

D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.08 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.

3. Multiple, Straight, Horizontal Piping Runs: Field fabricated, heavy duty trapeze. Fabricate from steel shapes and rod diameters as required for loads per MSS SP-58 and MSS SP-69. Verify rod diameter with structural engineer for multiple pipe trapeze hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install supports for vertical copper tubing every 10 feet.

E. Install supports for vertical steel piping every 15 feet.

F. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾"	4	4	3/8
1" to 2"	6	6	3/8
2½" to 4"	6	6	½
5" and Greater	4	4	7/8

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions and prior approved spacing by the structural engineer.

3.09 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.

2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.

3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.10 ESCUTCHEON INSTALLATION

A. Install escutcheons for all penetrations of walls, ceilings, and floors. Escutcheons in areas exposed to view shall have a chrome plated finish.
B. Provide chrome plated escutcheons for all piping penetration under sinks and within cabinets.

3.11 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for all pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

D. Install sleeves in new partitions, slabs, and walls as they are built.

E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.

2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe or stack sleeve fittings.

    a. Extend sleeves 2 inches above finished floor level.

    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

    a. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
    b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.

5. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).

    b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.

    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.12 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.13 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.

2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.

   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.

4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests: The following minimum tests shall be performed. Review procedures with the local jurisdiction and provide any additional tests or procedures required.

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.

3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

4. Cap and subject piping to static water pressure of 1.5 times the normal operating pressure, 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.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.

6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Submit test and inspection reports.

3.15 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.

2. Open shutoff valves to fully open position.

3. Open throttling valves to proper setting.

4. Remove plugs used during testing of piping and for temporary sealing of piping during installation.

5. Remove and clean strainer screens. Close drain valves and replace drain plugs.

6. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.

7. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.16 CLEANING

A. Provide the following minimum cleaning and disinfecting procedures as follows. Notify the Engineer seven (7) days in advance of disinfection procedures.

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.

2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures as described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 22 11 16

SECTION 22 11 19

DOMESTIC WATER PIPING SPECIALTIES

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes the following domestic water piping specialties:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated water mixing valves.
6. Strainers.
7. Outlet boxes.
8. Hose stations.
9. Hose bibbs.
10. Wall hydrants.
11. Ground hydrants.
12. Post hydrants.
13. Drain valves.
14. Water hammer arresters.
15. Air vents.
16. Trap-seal primer valves.

B. Related Sections include the following:

1. Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers, pressure gages, and flow meters in domestic water piping.

2. Division 22 Section "Domestic Water Piping" for water meters.

3. Division 22 Section “Plumbing Fixtures” for field installed components provided with plumbing fixtures.

1.03 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type of product indicated.

C. Shop Drawings: Diagram power, signal, and control wiring.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

C. Lead Free Requirements: All plumbing pipes, fittings, valves, fixtures, and other components in systems providing water for human consumption shall be 'lead-free' in accordance with the "Reduction of Lead in Drinking Water Act" and the "Safe Drinking Water Act", where the term 'lead-free' is defined to mean – "not containing more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures."

PART 2: PRODUCTS

2.01 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Standard: ASSE 1001.
2. Size: NPS 1/4 to NPS 3, as required to match connected piping.
3. Body: Bronze.
4. Inlet and Outlet Connections: Threaded.
5. Finish: Rough bronze in mechanical or boiler room. Chrome plated in all other areas.

B. Hose-Connection Vacuum Breakers:

1. Standard: ASSE 1011.
2. Body: Bronze, nonremovable, with manual drain.
3. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
4. Finish: Rough bronze in mechanical rooms or boiler rooms. Chrome plated in all other areas.

C. Pressure Vacuum Breakers:

1. Standard: ASSE 1020.
2. Operation: Continuous-pressure applications.
3. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
4. Size: Full line size as indicated on drawings.
5. Valves: Ball type, on inlet and outlet.

2.02 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers

1. Standard: ASSE 1013.

2. Operation: Continuous-pressure applications.

3. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.

4. Size: Full line size as indicated on drawings.

5. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or that is FDA approved for NPS 2-1/2 (DN 65) and larger.

6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.

7. Configuration: Designed specifically for horizontal or vertical flow as installed.

8. Accessories:

   a. Valves: Ball type with threaded ends on inlet and outlet of NPS 2 and smaller; outside screw and yoke gate-type with flanged ends on inlet and outlet of NPS 2-1/2 and larger.

   b. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.

B. Hose-Connection Backflow Preventers:

1. Standard: ASSE 1052.
2. Inlet Size: NPS 1/2 or NPS 3/4.
3. Outlet Size: Garden-hose thread complying with ASME B1.20.7.
4. Capacity: At least 3-gpm flow.

C. Additional Backflow Preventer Requiremnts:

1. Hose thread water outlets must be provided with ASSE 1052 non-removable hose bibb-type backflow preventers, ASSE 1011 non-removable hose bibb type vacuum breakers, or ASSE 1001 atmospheric vacuum breakers installed at least 6 inches above the highest point of usage on the discharge side of the last control valve (see Minnesota Rules, Chapter 4714, Sections 603.5.7 and 301.1.2).

2. Wall hydrants must meet ASSE standard 1019 (see Table 603.2). Where permitted by the administrative authority, wall hydrants may utilize non-removable ASSE 1052 backflow preventers or non-removable ASSE 1011 vacuum breakers and provision is made to protect from freezing (see Minnesota Rules, Chapter 4714, Sections 603.5.7, 312.6, and 301.1.2).

2.03 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Conbraco Industries, Inc.
   b. Watts Industries, Inc.; Water Products Div.
   c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1003.

3. Pressure Rating: Initial working pressure of 150 psig.

4. Size: Full line size as indicated on drawing.

5. Design Flow Rate: Refer to drawings.

6. Design Inlet Pressure: Refer to drawings.

7. Design Outlet Pressure Setting: Refer to drawings.

8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that is FDA approved for NPS 2-1/2 and NPS 3.

9. Valves for Booster Heater Water Supply: Include integral bypass.

10. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and NPS 3.

2.04 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Industries; Bell & Gossett Div.
d. NIBCO INC.
e. Taco, Inc.
f. Watts Industries, Inc.; Water Products Div.

2. Type: Ball valve with two readout ports and memory setting indicator.

3. Body: Bronze,

4. Size: Same as connected piping, but not larger than NPS 2.

B. Cast-Iron Calibrated Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong International, Inc.
b. Flo Fab Inc.
c. ITT Industries; Bell & Gossett Div.
d. NIBCO INC.
e. Watts Industries, Inc.; Water Products Div.

2. Type: Adjustable with Y-pattern globe valve, two readout ports, and memory-setting indicator.

3. Size: Same as connected piping, but not smaller than NPS 2-1/2.

2.05 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lawler Manufacturing Company, Inc.
b. Powers; a Watts Industries Co.

2. Hot water distribution systems / master mixing valves shall conform to Standard: ASSE 1017.

3. Emergency eyewash shall be supplied with an approved automatic temperature control mixing valve that shall conform to Standard: ASSE 1070.

4. Emergency eyewash/showers shall be supplied with an approved automatic temperature control mixing valve that shall conform to Standard: ASSE 1071.

5. All public lavatory sinks shall be supplied with an approved automatic temperature control mixing valve that shall conform to Standard: ASSE 1070.

6. Showers supplied with an individual control valves shall be supplied with an approved automatic temperature control mixing valve that conforms to ASSE 1016.

7. Multiple (gang) showers supplied with a single-tempered water supply pipe shall have the water supply for the showers controlled by an approved automatic temperature control mixing valve that conforms to ASSE 1069.

8. Pressure Rating: 125 psig.

9. Type: Exposed-mounting, thermostatically controlled water mixing valve.

10. Material: Bronze body with corrosion-resistant interior components.

11. Connections: Threaded inlets and outlet.

12. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, temperature setpoint adjustment, and a dial thermometer on the mixed water outlet.

13. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.

14. Tempered-Water Setting: 110 F.

15. Valve Finish: Rough bronze.

16. Piping Finish: Copper.

2.06 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum, unless otherwise indicated.

2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.

3. End Connections: Threaded for NPS 2 and smaller;flanged for NPS 2-1/2 and larger.

4. Screen: Stainless steel with round perforations, unless otherwise indicated.

5. Drain: Factory-installed, hose-end drain valve.

2.07 OUTLET BOXES

A. Icemaker Outlet Boxes:

1. Mounting: Recessed.
2. Material and Finish: Enameled-steel or epoxy-painted-steel box and faceplate.
3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 or smaller copper tube outlet.
4. Supply Shutoff Fitting: Ball valves and NPS 1/2 copper, water tubing.

2.08 HOSE BIBBS

A. Hose Bibbs:

1. Standard: ASME A112.18.1 for sediment faucets.
2. Body Material: Bronze.
3. Seat: Bronze, replaceable.
4. Supply Connections: Full line size as indicated on the drawings, threaded or soldered joints.
5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
6. Pressure Rating: 125 psig.
7. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
8. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
9. Finish for Finished Rooms: Chrome or nickel plated.
10. Operation for Equipment Rooms: Wheel handle or operating key.
11. Operation for Finished Rooms: Wheel handle or Operating key.
12. Include operating key with each operating-key hose bibb.
13. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.09 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Standard: ASME A112.21.3M for concealed-outlet, self-draining wall hydrants.
2. Pressure Rating: 125 psig.
3. Operation: Loose key.
4. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
5. Inlet: Full line size as indicated on the drawings.
6. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
7. Box: Deep, flush mounting with cover.
8. Box and Cover Finish: Polished nickel bronze.
9. Outlet: Exposed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
10. Nozzle and Wall-Plate Finish: Polished nickel bronze.
11. Operating Keys(s): Two with each wall hydrant.

2.10 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Standard: ASSE 1010 or PDI-WH 201.
2. Type: Copper tube with piston.
3. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.
4. Provide at all locations as described under installation section.

2.11 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Standard: ASSE 1018.
2. Pressure Rating: 125 psig minimum.
3. Body: Bronze.
4. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
5. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
6. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.12 EXPANSION TANKS

A. Equal to Watts Deta diaphragm type pre-pressurized expansion tanks welded steel construction, tested and stamped by ASME for working pressure of 125 psig and precharged to the minimum operating pressure. Provide a minimum of 15 gallon expansion tank unless otherwise sized on the drawings. Diaphragm shall be field replaceable.

PART 3: EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.

1. Locate backflow preventers in same room as connected equipment or system.

2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.

3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install balancing valves in locations where they can easily be adjusted.

E. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.

1. Install thermometers and water regulators if specified.
2. Install cabinet-type units recessed in or surface mounted on wall as specified.

F. Install Y-pattern strainers for water on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.

1. Install shutoff valve on outlet if specified.

2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install nonfreeze, nondraining-type post hydrants set in concrete or pavement.

J. Install freeze-resistant yard hydrants with riser pipe set in concrete or pavement. Do not encase canister in concrete.

K. Install water hammer arresters in water piping according to PDI-WH 201. Provide and install a water hammer arrester in an accessible location at the end of each water main, at the top of all main water supply risers, near

individual special equipment, at water closet bathroom groups and where also specifically shown on the drawings. Where required, provide suitable recessed boxes with access panels.

L. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

M. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

N. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each pressure vacuum breaker on reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.04 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 11 19

SECTION 22 13 16

SANITARY WASTE AND VENT PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes the following for soil, waste, and vent piping inside the building:

1. Pipe, tube, and fittings.
2. Special pipe fittings.

B. Related Sections include the following:

1. Division 22 Section "Sanitary Sewerage Pumps."

2. Division 22 Section "Chemical Waste Systems" for chemical-waste and vent piping systems.

1.03 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.04 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.

2. Sanitary Sewer, Force-Main Piping: 100 psig.

1.05 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For pipe, tube, fittings, and couplings.

C. Field quality control inspection and test reports.

1.06 QUALITY ASSURANCE

A. Comply with the following Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable State Codes.
2. ASTM A 888: Standard Specifications for Hubless Cast Iron Soil Pipe and Fittings.
3. ASTM A 74: Standard Specifications for Hub and Spigot Cast Iron Soil Pipe and Fittings.
4. ASTM C 564: Standard Specifications for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
5. ASTM C 1277: Standard Shielded Couplings for Hubless Cast Iron Pipe and Fittings.

6. ASTM C 1540: Heavy duty shielded couplings for Hubless Cast Iron Pipe and Fittings.
7. ASTM E 84: Standard Specifications for Surface Burning Characteristics

B. Piping material shall bear label, stamp, or other markings of specified testing agency.

PART 2: PRODUCTS

2.01 PIPING MATERIALS

A. Hubless Cast Iron Soil Pipe and Fittings: Conform to the requirements of ASTM A 74 and ASTM A888/CISPI 301. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

1. Standard shielded couplings: Conform to ASTM C1277 assembly. Provide with stainless steel metal shield, stainless steel bands and tightening devices and ASTM C564 rubber sleeve with integral center pipe stop.

2. Heavy duty shielded couplings: Conform to ASTM C1540. Provide with stainless steel metal shield, stainless steel bands and tightening devices and ASTM C564 rubber sleeve with integral center pipe stop.

3. No-Hub Couplings: No-Hub couplings shall conform to CIPI Standard 310 (most current addition) and shall be listed by NSF International

B. Service Weight Hub and Spigot Cast Iron Soil Pipe and Fittings: Conform to the requirements of ASTM A 74 and ASTM A888/CISPI 301. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and be listed by NSF International.

1. Standard shielded couplings: Conform to ASTM C1277 assembly. Provide with stainless steel metal shield, stainless steel bands and tightening devices and ASTM C564 rubber sleeve with integral center pipe stop.

2. Heavy duty shielded couplings: Conform to ASTM C1540. Provide with stainless steel metal shield, stainless steel bands and tightening devices and ASTM C564 rubber sleeve with integral center pipe stop.

3. No-Hub Couplings: No-Hub couplings shall conform to CIPI Standard 310 (most current addition) and shall be listed by NSF International

C. PVC sewer pipe and fittings. Conform to ASTM D2665 for pipe and fittings with solvent welded joints using solvents conforming to ASTM D2564.

D. Copper Tube: ASTM B 88, Type L Water Tube, drawn temper with ASTM B16.22 wrought copper solder joint fittings.

PART 3: EXECUTION

3.01 PIPE APPLICATIONS

A. Above Ground: Install hubless cast iron soil pipe and fittings with heavy duty shielded couplings.

B. Below Ground: Install PVC sewer pipe and fittings.

C. Indirect Waste: Install Type L, drawn copper tube with wrought copper fittings and solder joints.

3.02 EXAMINATION

A. Verify all dimensions by field measurements. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

B. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.

C. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.

D. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.

E. Review soil testing information provided to verify conditions are suitable for piping installations.

F. Do not proceed until unsatisfactory conditions have been corrected.

3.03 UNDERGROUND PIPE INSTALLATION

A. Grade trench bottoms to provide a smooth, firm, and stable foundation, free from rock, throughout the length of the pipe.

B. Remove unstable, soft, and unsuitable materials at the surface upon which pipes are to be laid and backfill with clean sand or pea gravel to indicated invert elevation.

C. Shape bottom of trench to fit bottom ½ of the circumference of pipe. Fill unevenness with tamped granular sand backfill. At each pipe joint dig bell holes to relieve the bell of the pipe of all loads, and to ensure continuous bearing of the pipe barrel on the foundation.

D. Install underground building drains to conform with State Plumbing Code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual and Handbook. Lay underground building drains beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Maintain swab or drag in line and pull past each joint as it is completed.

E. Install building drain pitched down at minimum slope of 1/4" per foot (2 percent) for all piping.

F. Extend building drain to connect to sewer piping, of size and in location indicated for service entrance to building. Sewer piping is specified in a separate section of Division 2.

G. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

H. Install 1" thick extruded polystyrene over underground building drain piping not under building. Width of insulation shall extend minimum of 12" beyond each side of pipe. Install directly over, and center on pipe center line.

I. Make changes of direction using appropriate 45 degree wyes or long sweep bends. No change of direction in flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

3.04 JOINING PIPES AND FITTINGS

A. Cast-Iron Soil Pipe: Hubless joints shall be supported and restrained in accordance with ASTM 1540/CISPI 310 standards.

B. Soldered Joints: Use ASTM B813, water-flushable, lead-free flux; ASTM B32, lead-free-alloy solder, and ASTM B828 procedures, unless otherwise indicated.

3.05 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs: MSS Type 1, adjustable, steel clevis hangers.

3. Multiple, Straight, Horizontal Piping Runs: MSS SP-69 and MSS SP-89, field-fabricated trapeze pipe hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor. Support vertical cast iron piping at a minimum of every 15 feet. Support vertical copper tubing at a minimum every 10 feet.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾"	4	4	3/8
1" to 2"	4	4	3/8
2½" to 4"	4	4	½
5" and Greater	4	4	7/8

F. All above grade horizontal plastic/PVC piping shall be supported at a maximum spacing no greater than 32 inches.

G. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.

3.06 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.

2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.

3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

3.07 FIELD QUALITY CONTROL

A. Inspections:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.

2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests in accordance with State and Local code requirements in the presence of the plumbing official.

    a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.

    b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the Minnesota Plumbing Code.

3. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspected by the plumbing official.

4. Reports: Prepare inspection reports, signed by the plumbing official.

B. Piping System Test:

1. Test for leaks and defects all new drainage and vent piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.

2. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.

3. In the absence of State or Local code requirements, the following minimum level of testing shall be performed. Drainage and Venting System Testing Procedures:

    a. Rough Plumbing: Except for outside leaders and perforated or open jointed drain tile, test the piping of plumbing drainage and venting systems upon completion of the rough piping installation as follows:

        1) Cast Iron Piping Systems:

            a. Attach an air compressor or testing apparatus to any suitable opening and close all other inlets and outlets to the system by means of proper testing plugs. Plaster of paris shall not be used in roof terminals. Air shall be forced tinto the system until there is a uniform pressure of five piunds per square inch on the portion of the system being tested. The pressure shall remain constant for 15 minutes without the addition of air.

        2) Thermoplastic Piping Systems:

            b. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts through completion of the inspection. Inspect all joints for leaks. The contractor shall pre-test the systems with air when necessary to avoid possible damage to finished materials and surfaces.

    b. Finished Plumbing: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.

4. Repair all leaks and defects using new materials and re-test system or portion thereof until satisfactory results are obtained.

5. Prepare reports for all tests and required corrective action.

3.08 ADJUSTING AND CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Clean drain strainers, domes, and traps. Remove dirt and debris.

C. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

D. Place plugs in ends of unoccupied piping at end of day and when work stops.

3.09 PROTECTION

A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.

B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 22 13 16

SECTION 22 13 19

SANITARY WASTE PIPING SPECIALTIES

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes the following sanitary drainage piping specialties:

1. Backwater valves.
2. Cleanouts.
3. Floor drains.
4. Trench drains.
5. Roof flashing assemblies.
6. Through-penetration firestop assemblies.
7. Miscellaneous sanitary drainage piping specialties.
8. Flashing materials.
9. Oil interceptors.

B. Related Sections include the following:

1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

2. Division 22 Section "Plumbing Fixtures" for specialties provided with plumbing fixtures and requiring installation.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. FOG: Fats, oils, and greases.

C. FRP: Fiberglass-reinforced plastic.

D. HDPE: High-density polyethylene plastic.

E. PE: Polyethylene plastic.

F. PP: Polypropylene plastic.

G. PVC: Polyvinyl chloride plastic.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories for the following:

1. Floor drains.
2. Trench drains.
3. Oil interceptors.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.06 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2: PRODUCTS

2.01 CLEANOUTS

A. Metal Cleanouts:

1. Standard: ASME A112.36.2M cast iron for cleanout test tee.

2. Size: Same as connected drainage piping.

3. Body Material: Match connected piping material and connection method.

4. Closure: Countersunk plug.

5. Options – Floor Cleanouts

a. Finished floors with asphalt, vinyl, rubber or other composition tile: Bronze plug cleanout with nickel bronze frame and recessed cover. Josam 58010-12-22.

b. Unfinished floors and traffic areas: Bronze plug cleanout with cast iron frame and cover. Josam 58000-5-22.

c. Finished walls and ceilings: Provide threaded bronze plug with seating flanges and four (4) square lugs for plug removal. Install plug with lead gasket. Provide nickel bronze square frame and cover with minimum opening size of 6”x 6”. Josam 58640.

d. Unfinished area waste stacks: Provide threaded bronze plug with seating flange and four (4) square lugs for plug removal. Install plug with lead gasket.

e. Carpeted areas: Provide Josam 58000-14 with carpet marker.

f. Closure: Brass plug with straight threads and gasket.

g. Adjustable Housing Material: Cast iron with threads.

h. Frame and Cover Material:

1) Finished Areas: Polished bronze.
2) Unfinished Areas: Rough bronze.

i. Carpeted Areas: Stainless steel carpet marker with vandalproof screw.

6. Options – Wall Cleanouts

a. Closure: Countersunk brass plug.
b. Closure Size: Same as cleanout size.
c. Wall Access: Round, flat, chrome plated brass coverplate with screw.

2.02 FLOOR DRAINS

A. Subject to compliance with requirements, provide drainage systems form one of the following:

1. Josam Mfg. Co.
2. Sioux Chief Mfg. Co.
3. Tyler Pipe; Subs, of Tyler Corp.
4. Zurn Industries Inc,; Hydromechanics Div.
5. Watts Regulator Company

B. All floor drains on grade shall be supplied with backwater valves unless otherwise noted

C. General: Provide floor drains of size as indicated on drawings; and type, including features, as specified herein: (Typical units listed below are of Josam manufacture). Refer to drawings for no-hub connection size for each individual floor drain.

D. Floor Drain Type FD-1: Coated cast iron floor drain with trap with double drainage flange, weepholes, and adjustable satin nikaloy round "Super-Flo" strainer. Josam Series No. 30000-AJ. Provide with 4'-0" x 4'-0" chloraloy flashing.

1. These drains are for use on or above grade in toilet rooms, showers, service sinks and other finished areas.

2. Provide backwater valve where floor drain is located on grade.

E. Floor Drain Type FD-2: Coated cast iron with deep seal trap with double drainage flange, "Wejloc" invertible non-puncturing flashing collar, weep holes, bottom outlet and adjustable satin bronze round "Super-Flo" strainer. Joasm Series Nol 30000-AJ. Provide with 4'-0" x 4'-0" chloraloy flashing.

1. These drains are for use above grade in mechanical rooms, elevator shafts, and other unfinished areas.

F. Floor Drain Type FD-3: Coated cast iron floor drain with adjustable extension collar without trap. Provide with heavy ductile iron grate and 7" deep removable sediment bucket. Josam Series No. 32330.

1. This drain is for use on grade in garage.

2.03 TRENCH DRAINS

A. Subject to compliance with requirements, provide trench drainage systems form one of the following:

1. Aco.
2. Polydrain
3. Zurn

B. Trench Drain TD-1: Pre-Cast Sloped Trench Drain System

1. Pre-cast high density polyethylene structural composite trench drains shall be Zurn Model Z886, 6” wide pre-sloped trench drainage system with Load Class “C” heavy duty galvanized ductile iron slotted grate rated for heavy truck traffic, or prior approved equal. Trench drain system shall be modular type.

2. Trench drain system shall be pre-cast from a corrosion resistant polyethylene structural composite including interlocking modular components for on-site assembly and installation. All channels shall have an HD integral solid steel rail support frame with anchor studs to provide permanent stability for channel top edge. Provide all necessary accessories, supports, clips, and appurtenances.

3. Pre-cast material shall have a compressive strength of 32, 000 PSI and tensile strength of 16,400 PSI and shall be frost proof, salt proof, inert under dilute acid and alkali conditions and water absorption rate shall not exceed .15%.

4. Install complete trench drain assembly in accordance with the manufacturer’s most current published installation instructions.

2.04 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

B. Description: Manufactured assembly made of 6.0-lb/sq. ft. thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.

1. Extended Vent Cap: With field-installed, vandal-proof vent cap.

2.05 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.

2. Size: Same as connected waste piping.

a. NPS 2: 4-inch minimum water seal.
b. NPS 2-1/2and Larger: 5-inch minimum water seal.

B. Air-Gap Fittings:

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.

2. Body: Bronze or cast iron.

3. Inlet: Opening in top of body.

4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.

2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.

2. Size: Same as connected stack vent or vent stack.

E. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.

2. Size: Same as connected stack vent or vent stack.

2.06 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:

1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.

2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:

1. General Applications: 12 oz./sq. ft.

2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

2.07 FLAMMABLE WASTE INTERCEPTOR

A. Flammable Waste Interceptor. Refer to drawings for additional requirements.

1. Type: Factory-fabricated interceptor in accordance with State Code.

2. Body Material: 6” monolithic poured concrete, 3/16” welded steel or cast iron.

3. Body Extension: Required.

4. Exterior Coating: Corrosion-resistant enamel.

5. End Connections: Flanged or hub.

6. Mounting: Recessed, flush with floor.

7. Provide adjustable field cut riser with 450 lb (1,000 pound outdoor) rated cover

PART 3: EXECUTION

3.01 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

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 NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. An additional cleanout shall be provided in a drainage line for aggregate horizontal change of direction exceeding 135 degrees.

4. Locate at minimum intervals of 50 feet for piping NPS 3 and smaller and 100 feet for larger piping.

5. Locate a building cleanout before exiting the building.

6. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Provide a cleanout at its upper terminal for each horizontal drain branch, including floor drain branches.

F. Provide a cleanout at each waste and vent piping connection where new piping connects to existing for testing.

G. Provide cleanouts whether or not specifically shown on the drawings in accordance with Minnesota Rules, Chapter 4714, Section 707.4

H. Provide the following cleanouts whether or not specifically shown on the drawings (Refer to Minnesota Plumbing Code section 4715.1000).

1. Provide a cleanout between the building drain and the building sewer.
2. A cleanout shall be provided at or near the foot of each vertical riser.
3. A cleanout shall be provided at or near the foot of all sanitary and vent piping locations where piping comes out of the ground.
4. Each horizontal branch drain pipe shall be provided with a cleanout at its upper terminal.
5. Floor set fixtures shall be provided with an integral cleanout or a cleanout installed as close as possible to the fixture on the horizontal branch serving the fixture.
6. Provide a cleanout on a common vertical fixture drain or common vent serving two fixture traps that connect to a vertical drain at the same level.
7. Cleanouts shall be the same nominal size, up to 4 inches, as the pipe serving the fixture.
8. Distance between cleanouts in horizontal piping shall not exceed 50 feet for piping 3 inches or smaller and not over 100 feet for 4 inches and larger.
9. Provide a Cleanout at all increases in pipe size.(i.e. 2” to 3” and 3” to 4”, etc)
10. Cleanouts shall be installed in accessible locations.

I. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

J. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated, in accordance with manufacturer’s instructions.

K. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

L. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

M. Install deep-seal traps on floor drains and other waste outlets, if indicated.

N. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.

1. Exception: Fitting may be omitted if trap has trap-seal primer connection.

2. Size: Same as floor drain inlet.

O. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

P. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

Q. Install vent caps on each vent pipe passing through roof.

R. Install flammable waste trap and/or sediment traps, including trapping and venting according to authorities having jurisdiction and as indicated on the drawings.

1. Contractor shall field verify exact waste piping sizing and invert connection depth with supplied flammable/sediment trap connections. Contractor shall coordinate with manufacturer and add all required manhole/cleanout extensions, connections and sleeves.

S. Install wood-blocking reinforcement for wall-mounting-type specialties.

T. 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.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Flammable Waste Interceptors: Connect inlet, outlet, vent, and gravity drawoff piping to unit; flow-control fitting and vent to unit inlet piping; and gravity drawoff and suction piping to oil storage tank. Provide body manhole extension as required to install cover flush at finished floor level. Coordinate exact inlet invert elevations prior to ordering.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.

2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.

2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.

3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect field-assembled their installation, including piping and electrical connections, and to assist in testing.

B. Tests and Inspections:

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.

3.05 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain grease removal devices. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 13 19

SECTION 221513

GENERAL-SERVICE COMPRESSED-AIR PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes piping and related specialties for general-service compressed-air systems operating at 200 psig or less.

B. Related Sections include the following:

1. Division 22 Section "General-Service Packaged Air Compressors and Receivers" for general-service air compressors and accessories.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. CR: Chlorosulfonated polyethylene synthetic rubber.

C. EPDM: Ethylene-propylene-diene terpolymer rubber.

D. HDPE: High-density polyethylene plastic.

E. NBR: Acrylonitrile-butadiene rubber.

F. PE: Polyethylene plastic.

G. PVC: Polyvinyl chloride plastic.

H. High-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures between 150 and 200 psig.

I. Low-Pressure Compressed-Air Piping: System of compressed-air piping and specialties operating at pressures of 150 psig or less.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For the following:

1. Plastic pipes, fittings, and valves.
2. Dielectric fittings.

3. Flexible pipe connectors.
4. Safety valves.
5. Pressure regulators. Include rated capacities and operating characteristics.
6. Quick couplings.

C. Brazing and welding certificates.

D. Qualification Data: For Installers.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For general-service compressed-air piping specialties to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Installer Qualifications:

1. Extruded-Tee Outlet Procedure: Qualify operators according to training provided by T-DRILL Industries Inc., for making branch outlets.

2. Pressure-Seal Joining Procedure for Copper Tubing: Qualify operators according to training provided by Viega; Plumbing and Heating Systems.

3. Pressure-Seal Joining Procedure for Steel Piping. Qualify operators according to training provided by Victaulic Company.

B. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications," or to AWS B2.2, "Standard for Brazing Procedure and Performance Qualification."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

D. ASME Compliance:

1. Comply with ASME B31.1, "Power Piping," for high-pressure compressed-air piping.
2. Comply with ASME B31.9, "Building Services Piping," for low-pressure compressed-air piping.

PART 2: PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Schedule 40, Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black or hot-dip zinc coated with ends threaded according to ASME B1.20.1.

1. Steel Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized seamless steel pipe. Include ends matching joining method.

2. Malleable-Iron Fittings: ASME B16.3, Class 150 or 300, threaded.

3. Malleable-Iron Unions: ASME B16.39, Class 150 or 300, threaded.

4. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel, threaded.

5. Wrought-Steel Butt-Welding Fittings: ASME B16.9, Schedule 40.

6. Steel Flanges: ASME B16.5, Class 150 or 300, carbon steel.

B. Transition Couplings for Metal Piping: Metal coupling or other manufactured fitting same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.02 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.03 VALVES

A. Metal Ball, Butterfly, Check, Gate, and Globe Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."

2.04 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.

B. Dielectric Unions: 250 psig at 180 degrees F., solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges: Factory-fabricated, bolted, companion-flange assembly. Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Kits: 300 psig rated, non-conducting materials for field assembly.

1. Gasket: Neoprene or phenolic.
2. Bolt Sleeves: Phenolic or polyethylene.
3. Washers: Phenolic with steel backing washers.

E. Dielectric Couplings: 300 psig at 225 degrees F., galvanized steel coupling.

1. End Connections: Female threaded.
2. Lining: Inert and noncorrosive, thermoplastic.

F. Dielectric Nipples: ASTM F1545, 300 psig at 225 degrees F., electroplated steel nipple.

1. End Connections: Male threaded.
2. Lining: Inert and noncorrosive, propylene.

2.05 FLEXIBLE PIPE CONNECTORS

A. 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Flex-Hose Co., Inc.
2. Flexicraft Industries.
3. Metraflex, Inc.
4. Unaflex, Inc.

C. Stainless-Steel-Hose Flexible Pipe Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.

1. Working-Pressure Rating: 250 psig minimum.
2. End Connections, NPS 2 and Smaller: Threaded steel pipe nipple.
3. End Connections, NPS 2-1/2 and Larger: Flanged steel nipple.

2.06 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with set screws.

2.07 ESCUTCHEONS

A. General Requirements: Manufactured wall and ceiling escutcheons and floor plates, with ID to closely fit around pipe and tube and OD that completely covers opening.

B. One-Piece, Deep-Pattern Escutcheons: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Escutcheons: With set screw.

1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Escutcheons: With concealed hinge and set screw.

1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Escutcheons: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Escutcheons: With concealed hinge, set screw, and chrome-plated finish.

G. One-Piece, Floor-Plate Escutcheons: Cast iron.

H. Split-Casting, Floor-Plate Escutcheons: Cast brass with concealed hinge and set screw.

2.08 SPECIALTIES

A. Safety Valves: ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," construction; National Board certified, labeled, and factory sealed; constructed of bronze body with poppet-type safety valve for compressed-air service.

1. Pressure Settings: Higher than discharge pressure and same or lower than receiver pressure rating.

B. Air-Main Pressure Regulators: Bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 250-psig inlet pressure, unless otherwise indicated.

1. Type: Pilot operated.

C. Air-Line Pressure Regulators: Diaphragm operated, bronze body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

D. Air-Line Pressure Regulators: Diaphragm operated, aluminum alloy or plastic body, direct acting, spring-loaded manual pressure-setting adjustment, and rated for 200-psig minimum inlet pressure, unless otherwise indicated.

E. Automatic Drain Valves: Stainless-steel body and internal parts, rated for 200-psig minimum working pressure, capable of automatic discharge of collected condensate. Include mounting bracket if wall mounting is indicated.

F. Coalescing Filters: Coalescing type with activated carbon capable of removing water and oil aerosols; with color-change dye to indicate when carbon is saturated and warning light to indicate when selected maximum pressure drop has been exceeded. Include mounting bracket if wall mounting.

G. Mechanical Filters: Two-stage, mechanical-separation-type, air-line filters. Equip with deflector plates, resin-impregnated-ribbon-type filters with edge filtration, and drain cock. Include mounting bracket if wall mounting.

H. Air-Line Lubricators: With drip chamber and sight dome for observing oil drop entering air stream; with oil-feed adjustment screw and quick-release collar for easy bowl removal. Include mounting bracket if wall mounting.

1. Provide with automatic feed device for supplying oil to lubricator.

2.09 QUICK COUPLINGS

A. 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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aeroquip Corporation; Eaton Corp.
2. Foster Manufacturing, Inc.
3. Milton Industries, Inc.
4. Schrader-Bridgeport; Amflo Div.
5. TOMCO Products Inc.
6. Tuthill Corporation; Hansen Coupling Div.

C. General Requirements for Quick Couplings: Assembly with locking-mechanism feature for quick connection and disconnection of compressed-air hose.

D. Automatic-Shutoff Quick Couplings: Straight-through brass body with O-ring or gasket seal and stainless-steel or nickel-plated-steel operating parts.

1. Socket End: With one-way valve and threaded inlet for connection to piping or threaded hose fitting.

2. Plug End: Straight-through type with barbed outlet for attaching hose.

PART 3: EXECUTION

3.01 PIPING APPLICATIONS

A. Compressed-Air Distribution Piping:

1. 2” and Smaller: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

2. 2-1/2” to 4”: Schedule 40, black-steel pipe; threaded, malleable-iron fittings; and threaded joints.

3.02 VALVE APPLICATIONS

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for metal general-duty valves. Use metal valves, unless otherwise indicated.

1. Metal General-Duty Valves: Use valve types specified in "Valve Applications" Article in Division 22 Section "General-Duty Valves for Plumbing Piping" according to the following:

    a. Low-Pressure Compressed Air: Valve types specified for low-pressure compressed air.

    b. High-Pressure Compressed Air: Valve types specified for medium-pressure compressed air.

    c. Equipment Isolation 2” and Smaller: Safety-exhaust, copper-alloy ball valve with exhaust vent and pressure rating at least as great as piping system operating pressure.

    d. Grooved-end valves may be used with grooved-end piping and grooved joints.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of compressed-air piping. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, air-compressor sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping concealed from view and protected from physical contact by building occupants, unless otherwise indicated and except in equipment rooms and service areas.

C. 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 otherwise indicated.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and to coordinate with other services occupying that space.

E. Install piping adjacent to equipment and machines to allow service and maintenance.

F. Install air and drain piping with 1 percent slope downward in direction of flow.

G. Install nipples, flanges, unions, transition and special fittings, and valves with pressure ratings same as or higher than system pressure rating, unless otherwise indicated.

H. Equipment and Specialty Flanged Connections:

    1. Use steel companion flange with gasket for connection to steel pipe.

    2. Use cast-copper-alloy companion flange with gasket and brazed[or soldered] joint for connection to copper tube. Do not use soldered joints for connection to air compressors or to equipment or machines producing shock or vibration.

I. Flanged joints may be used instead of specified joint for any piping or tubing system.

J. Install eccentric reducers where compressed-air piping is reduced in direction of flow, with bottoms of both pipes and reducer fitting flush.

K. Install branch connections to compressed-air mains from top of main. Provide drain leg and drain trap at end of each main and branch and at low points.

L. Install thermometer and pressure gage on discharge piping from each air compressor and on each receiver. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping."

M. Install piping to permit valve servicing.

N. Install piping free of sags and bends.

O. Install fittings for changes in direction and branch connections.

3.04 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. 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.

3.05 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Install shutoff valves and unions or flanged joints at compressed-air piping to air compressors.

C. Install shutoff valve at inlet to each automatic drain valve, filter, lubricator, and pressure regulator.

D. Install check valves to maintain correct direction of compressed-air flow to and from compressed-air piping specialties and equipment.

3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. 2” and Smaller: Use dielectric unions.

C. 2-1/2” to 4” Use dielectric flanges.

D. 5” and Larger: Use dielectric flange kits.

3.07 FLEXIBLE PIPE CONNECTOR INSTALLATION

A. Install flexible pipe connectors in discharge piping and in inlet air piping from remote air-inlet filter of each air compressor.

B. Install bronze-hose flexible pipe connectors in copper compressed-air tubing.

C. Install stainless-steel-hose flexible pipe connectors in steel compressed-air piping.

3.08 SPECIALTY INSTALLATION

A. Install safety valves on receivers in quantity and size to relieve at least the capacity of connected air compressors.

B. Install air-main pressure regulators in compressed-air piping at or near air compressors.

C. Install air-line pressure regulators in branch piping to equipment and tools.

D. Install coalescing filters in compressed-air piping at or near air compressors and upstream from mechanical filters.

E. Install mechanical filters in compressed-air piping at or near air compressors and downstream from coalescing filters.

F. Install air-line lubricators in branch piping to machine tools.

G. Install quick couplings at piping terminals for hose connections.

3.09 CONNECTIONS

A. Install unions, in piping 2” and smaller, adjacent to each valve and at final connection to each piece of equipment and machine.

B. Install flanges, in piping 2-1/2” and larger, adjacent to flanged valves and at final connection to each piece of equipment and machine.

3.10 SLEEVE INSTALLATION

A. Sleeves are not required for core-drilled holes.

B. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs using galvanized-steel pipe, galvanized-steel sheet or PVC pipe.

D. Install sleeves for pipes passing through concrete and masonry walls, gypsum board partitions, and concrete floor and roof slabs.

1. Wall Penetrations: Cut sleeves to length for mounting flush with both surfaces.

2. Floor Penetrations: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2” above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

E. Install sleeves in new walls and slabs as new walls and slabs are constructed.

F. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

1. PVC Pipe Sleeves: For pipes smaller than 6”.

2. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2” above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

a. Seal space outside of sleeve fittings with grout.

G. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

3.11 ESCUTCHEON INSTALLATION

A. 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.

   b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One piece stamped steel with set screw.

   c. Bare Piping at Ceiling Penetrations in Finished Spaces: One piece, stamped steel with set screw.

   d. Bare Piping in Unfinished Service Spaces: One piece, stamped steel with set screw.

   e. Bare Piping in Equipment Rooms: One piece, stamped steel with set screw.

   f. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece floor plate.

3.12 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.

   1. Vertical Piping: MSS Type 8 or 42, clamps.

   2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.

   3. Multiple, Straight, Horizontal Piping Runs: Field fabricated, heavy duty trapeze. Fabricate from steel shapes required for loads.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install supports for vertical copper tubing every 10 feet.

E. Install supports for vertical steel piping every 15 feet.

F. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	3/8
2-1/2	11	9	½
3	12	10	½
3-1/2	12	10	½
4	12	10	½

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.13 LABELING AND IDENTIFICATION

A. Install identifying labels and devices for general-service compressed-air piping, valves, and specialties. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.14 FIELD QUALITY CONTROL

A. Perform field tests and inspections.

B. Tests and Inspections:

1. Piping Leak Tests for Metal Compressed-Air Piping: Test new and modified parts of existing piping. Cap and fill general-service compressed-air piping with oil-free dry air or gaseous nitrogen to pressure of 50 psig above system operating pressure, but not less than 150 psig. Isolate test source and let stand for four hours to equalize temperature. Refill system, if required, to test pressure; hold for two hours with no drop in pressure.

2. Repair leaks and retest until no leaks exist.

3. Inspect filters, lubricators and pressure regulators for proper operation.

C. Prepare test reports.

END OF SECTION 22 15 13

SECTION 22 31 00

WATER SOFTENERS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes commercial water softening equipment.

1. Chemicals.
2. Water testing kits.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Water Softeners. Include rated capacities, operating characteristics, furnished specialties, and accessories.

2. Water testing kits.

B. Shop Drawings: For water softeners. Include plans, elevations, sections, details, and connections to piping systems.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For water softeners to include in emergency, operation, and maintenance manuals.

F. Special product warranty as indicated.

1.04 QUALITY ASSURANCE

A. NSF Standard: Provide water softeners constructed in accordance with NSF No. 44 "Standard for Caution Exchange Water Softeners."

B. Mineral Standard: Provide mineral (resin) products acceptable under state and local public health control regulations.

C. Electrical Component Standard: Provide components complying with NFPA 70 "National Electrical Code."

D. Listing and Labeling: Provide water softening equipment that is listed or labeled.

1. The terms "listed" and "labeled" shall be as defined in the National Electrical Code, Article 100.

2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.

E. State Plumbing Code Compliance: Comply with applicable provisions of State Building Code in the design, manufacture and installation of water softener.

F. Manufacturer/Product Selection: The Drawings indicate sizes, profiles, and dimensional requirements of water softeners. Water softeners having equal performance characteristics with deviations from indicated dimensions and profiles may be considered, provided deviations do not change the design concept or intended performance. The burden of proof of equality is on the proposer.

1.05 WARRANTY

A. Provide standard product warranty for water softeners covering:
   1. Attrition loss of mineral not to exceed 3 percent per year for first 3 years.
   2. Mineral not to be washed out of system during service run or backwashing period.
   3. Effluent turbidity not to be greater and color not to be darker than incoming water.
   4. Underdrain system, gravel, and mineral not to become fouled, either with turbidity or by dirt, rust, or scale from softening system, or present in soft water, while operating as noted in manufacturer's operating instructions.

1.06 MAINTENANCE SERVICE

A. Agreement to Maintain: Prior to Substantial Completion, submit 4 copies of Manufacturer's "Agreement for Continued Service and Maintenance" for water softener, for Owner's acceptance. Offer terms and conditions for furnishing chemicals and providing continued testing and servicing to include replacing materials and equipment. Term of agreement shall be for 1 year with option for one-year renewal.

1.07 EXTRA MATERIALS

A. Furnish extra materials listed below, matching installed products, packaged with protective covering for storage, and identified with labels clearly describing contents.
   1. Salt: Furnish salt in total quantity of not less than 4 times the regeneration rate, and not less than 500 lb. Deliver in 50-lb bags on pallets. Store where directed by Owner.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include the following:
   1. GE.
   2. Siemens
   3. US Filter
   4. Wigen Companies, Inc.
   5. Water Control Corporation
   6. Culligan

2.02 COMMERCIAL WATER SOFTENER

A. Factory-assembled, pressure-type, commercial water softeners having capacities and for electrical characteristics indicated.

B. Mineral Tanks:

1. Construction: Non-ASME fiberglass reinforced plastic. Comply with NSF 61.
2. Pressure Rating: 100 psig minimum.
3. Suitable for temperatures from 40°F to 100°F.
4. Freeboard: 50% minimum for backwash expansion above normal resin bed.
5. Support Skirt: Molded polypropylene base.
6. Lower Distribution: Hub and radial-arm or header-lateral type; fabricate from non-metallic pipe and fittings with individual, fine slotted, non-clogging plastic strainers. Arrange for even flow through resin bed.

C. Brine Tank: Combination measuring and wet salt storage system.

1. Tank and Cover Material: Fiberglass, 3/16 inch thick; or molded PE, 3/8 inch thick.
2. Brine Valve: Float operated and plastic fitted for automatic control of brine withdrawn and freshwater refill.
3. Size: Large enough for at least four regenerations at full salting.

D. Controls: Fully automatic; factory mounted on unit and factory wired.

1. Programmable electronic controller with LCD display and status/programming indicators. The controller shall display status of each tank with respect to service or regeneration, time of day, volume remaining, flow rate, totalizer, dates since regeneration, and prior service, volume used.

2. Adjustable duration of various regeneration steps.

3. Sequence of Operation: Program multiport pilot-control valve to automatically pressure-actuate main operating valve through steps of regeneration and return to service.

4. Means of manual operation of pilot-control valve if power fails.

5. Main Operating Valves: Industrial, automatic, with the following features:

   a. Slow opening and closing, nonslam operation.

   b. Isolated dissimilar metals within valve.

   c. Self-adjusting, internal, automatic brine injector that draws brine and rinses at constant rate independent of pressure.

   d. Valve for single mineral-tank unit with internal automatic bypass of raw water during regeneration.

   e. Sampling cocks for soft water.

   f. Special tools are not required for service.

6. Flow Control: Automatic, to control backwash and flush rates over wide variations in operating pressures, and that does not require field adjustments.

   a. For Single Mineral Tank Systems:

      1) Demand-Initiated Control. Equip single mineral-tank units with automatic-reset-head water meter that electronically activates cycle controller to initiate regeneration at preset total in gallons. Design so head automatically resets to preset total in gallons for next service run. The controller shall lockout regeneration during operator defined hours.

   b. For Multiple Tank Systems:

      1) Demand-Initiated Control. Equip each mineral tank of multiple mineral-tank units with automatic-reset-head water meters that electronically activates cycle controllers to initiate regeneration at

preset total in gallons. Design so heads automatically reset to preset total in gallons for next service run. Include electrical lockout to prevent simultaneous regeneration of both tanks.

E. Factory-Installed Accessories:

1. Piping, valves, tubing, and drains.
2. Sampling cock.
3. Main-operating-valve position indicator.

2.03 CHEMICALS

A. Mineral: High-capacity, sulfonated-polystyrene ion-exchange resin that is stable over entire pH range with good resistance to bead fracture from attrition or shock.

1. Exchange Capacity: 30,000 grains/cu. ft. of calcium carbonate of resin when regenerated with 15 lb of salt.

B. Salt for Brine Tanks: High-purity sodium chloride, free of dirt and foreign material. Rock and granulated forms are not acceptable.

1. Form: Processed, food-grade salt pellets.

2.04 ACCESSORIES

A. Pressure gages for hard water inlet and soft water outlet.

B. Sampling cocks for hard water inlet and soft water outlet for each tank.

C. Position indicator to indicate position of main operating valve.

2.05 WATER TESTING SETS

A. Provide complete water testing set for each water softener, for hardness tests, in metal container suitable for wall mounting.

2.06 ACCESSORIES

A. Pressure gages for hard water inlet and soft water outlet.

B. Sampling cocks for hard water inlet and soft water outlet for each tank.

C. Position indicator to indicate position of main operating valve.

2.07 WATER TESTING SETS

A. Provide complete water testing set for each water softener, for hardness tests, in metal container suitable for wall mounting.

PART 3: EXECUTION

3.01 CONCRETE BASES

A. Install reinforcing bars, and place anchor bolts and sleeves using manufacturer's installation template.

B. Allow concrete to cure before installation of equipment.

C. Clean exposed steel frames and apply 2 coats of rust-preventative metal primer and 2 coats of exterior, gloss, alkyd enamel in color selected by the Architect.

3.02 WATER SOFTENER INSTALLATION

A. Install water softening equipment level and plumb, on concrete bases in accordance with manufacturer's written instructions, layout drawings, the original design, and referenced standards. Maintain manufacturer's recommended clearances. Orient so controls and devices needing servicing are accessible.

B. Install pressure gages on water inlet and outlet piping of each water softener. Pressure gages are specified in Division 15 Section 15135 "Meters and Gages."

C. Install water testing sets near water softeners, wall-mounted, where indicated.

3.03 CONNECTIONS

A. Water Distribution Piping: Piping installation requirements are specified in Division 15 Section 15411 "Water Distribution Piping." The Drawings indicate the general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping adjacent to equipment to allow servicing and maintenance.

2. Connect water piping to units with shutoff valves and unions and provide full-size valved bypass around unit.

    a. Where water connections are made with dissimilar metal water distribution piping, make connections with dielectric fittings or dielectric unions.

3. Install drains as indirect wastes to spill into open drains or over floor drains.

B. Install brine lines and fittings furnished by manufacturer but not specified to be factory mounted.

C. Electrical Connections: Power wiring, including disconnect switches, is specified in Division 16.

1. Grounding: Connect unit components to ground in accordance with the National Electrical Code.

3.04 FIELD QUALITY CONTROL

A. Sample water softener effluent at one week intervals after start-up, for period of 3 weeks and prepare certified test report for each required water performance characteristic. Comply with the following ASTM standards:

1. ASTM D 859-80, "Test Methods for Silica in Water."
2. ASTM D 1067-82, "Test Methods for Acidity or Alkalinity of Water."
3. ASTM D 1068-87, "Test Methods for Iron in Water."
4. ASTM D 1126-86, "Test Methods for Hardness in Water."
5. ASTM D 1129-82b, "Definitions of Terms Relating to Water."
6. ASTM D 1888-78, "Test Methods for Particulate and Dissolved Matter in Water."
7. ASTM D 3370-82, "Practices for Sampling Water."

3.05 DEMONSTRATION

A. Start-Up Services: Provide the services of a factory-authorized service representative to provide start-up service and to demonstrate and train Owner's maintenance personnel as specified below.

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

2. Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventative maintenance.

3. Review data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

4. Schedule training with at least 7 days advance notice.

3.06 SYSTEM START-UP

A. Perform the following before start-up final checks:

1. Water piping systems tests completed.

2. Load Softener Tank: Install gravel to cover lower distribution system, add water; smooth gravel surface and add softening mineral.

3. Load Brine Tank: Add water and fill tank with salt.

4. Check for piping connections leaks.

5. Test operation of safety controls and devices.

B. Perform the following start-up procedures:

1. Energize circuits.

2. Adjust operating controls.

3.07 DEMONSTRATION AND TRAINING

A. Provide demonstration and training for Owner’s representative in accordance with Division 1 specification section 01820.

END OF SECTION 22 31 00

SECTION 22 34 00

FUEL-FIRED DOMESTIC WATER HEATERS

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes the following fuel-fired water heaters:

1. Commercial, atmospheric, storage, gas water heaters.
2. Commercial, high-efficiency, gas water heaters.
3. High Efficiency Gas Fired Semi-Instantaneous Water Heater
4. Water heater accessories.

1.03 DEFINITIONS

A. LP Gas: Liquefied-petroleum fuel gas.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

1. Prior to flue vent installation, engineered calculations and drawings must be submitted to Architect/Engineer to thoroughly demonstrate that size and configuration conform to recommended size, length and footprint for each submitted water heater.

C. Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 GPM to maximum value of water heater.

D. Shop Drawings: Diagram power, signal, and control wiring.

E. Source quality-control test reports.

F. Field quality-control test reports.

G. Operation and Maintenance Data: For water heaters to include in emergency, operation, and maintenance manuals.

H. Warranty: Special warranty specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Electrical Components, Devices and Accessories: Condensing water heaters must be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Performance Compliance: Condensing water heaters must be rated in accordance with ASHRAE 118.1 testing methods and verified by UL or AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

F. ASME Compliance: Condensing water heaters must be constructed in accordance with ASME Water heater and Pressure Vessel Code, Section IV (HLW) Potable Water Heaters. Heaters shall bear ASME Stamp as proof of compliance.

G. ASHRAE/IESNA 90.1 Compliance: Condensing water heaters shall have minimum efficiency according to "Gas and Oil Fired water heaters - Minimum Efficiency Requirements," when tested in accordance with Section G.1 “Method of Test for Measuring Thermal Efficiency” and G.2 “Method of Test for Measuring Standby Loss” of ANSI Z21.10.3

H. UL Compliance. Condensing water heaters must be tested for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Condensing water heaters shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

I. NOx Emission Standards. When installed and operated in accordance with manufacturer’s instructions, condensing water heaters hall comply with the NOx emission standards outlined in South Coast Air Quality Management District (SCAQMD), Rule 1146.2; and the Texas Commission on Environmental Quality (TCEQ), Title 30, Chapter 117, Rule 117.465.

J. Low Lead Compliance: Condensing water heaters must be third party classified to meet the requirements of ANSI/NSF 372, hence that the weighted average of the wetted surface area in contact with potable water must be no greater than 0.25% lead content.

1.06 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

1.07 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Period(s): One year from date of Substantial Completion:

3. Warranty Period for Fire-Tube, Semi-Instantaneous, Condensing Water heaters:

   a. The pressure vessel shall carry a 10-year from shipment, non-prorated, limited warranty against any failure due to waterside corrosion, mechanical defects, or workmanship. The heat exchanger shall carry a

10-year from shipment, prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects, or workmanship.

b. Manufacturer labeled control panels are conditionally warranted against failure for two (2) years from shipment.

c. All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment.

4. Warranty Period for Tank-Type Water Heaters:

a. The pressure vessel shall carry a 5-year from date of substantial completion, non-prorated, limited warranty against any failure due to mechanical defects or workmanship

b. All other components shall carry a 1-year from date of substantial completion, non-prorated, limited warranty against any failure due to mechanical defects or workmanship.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

1. High Efficiency Gas-Fired Water Heaters (integral storage tank):

a. Lochinvar Water Heater Corp.
b. PVI Industries, Inc.
c. A.O. Smith Water Products; A.O. Smith Corp.
d. Bradford-White Corp.

2. Compression Tanks

a. AMTROL, Inc.
b. Aerco
c. American Wheatley
d. Taco, Inc.
e. Watts Regulator
f. Wessels Co.

2.02 HIGH-EFFICIENCY GAS WATER HEATERS (integral storage tank):

A. Comply with ANSI Z21.10.3/CSA 4.3. Refer to drawing for capacity and configuration.

B. Description: Manufacturer's proprietary design to provide at least 95 percent combustion efficiency at optimum operating conditions. Following features and attributes may be modified or omitted if water heater otherwise complies with requirements for performance.

C. Storage-Tank Construction: ASME-code steel with 150-psig minimum working-pressure rating.

1. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.

a. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.

b. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.

2. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

3. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

D. Factory-Installed, Storage-Tank Appurtenances:

1. Anode Rod: Non-sacrificial, titanium, powered.

2. Dip Tube: Provide unless cold-water inlet is near bottom of tank.

3. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.

4. Insulation: Comply with ASHRAE/IESNA 90.1. Surround entire storage tank except connections and controls.

5. Jacket: Steel with enameled finish.

6. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

E. Burner or Heat Exchanger: Sealed combustion designed for direct venting with PVC material. Comply with UL 795 or approved testing agency requirements for high-efficiency water heaters and for natural-gas fuel.

F. Temperature Control: Integrated solid state temperature and ignition components with integral diagnostics, LED fault display capability and digital display of temperature settings.

G. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.

H. Energy Management System Interface: Normally closed dry contacts for remote monitoring, enabling and disabling water heater, leak detection and fault alert. MODBUS/BACnet Upgradability.

I. Venting

1. The exhaust vent must be UL Listed for use with Category II, III and IV appliances and compatible with positive pressure, condensing flue gas service. UL- listed vents of Al 29-4C stainless steel must be used with water heaters.

2. The minimum exhaust vent duct size for each water heater is four-inch diameter.

3. Combustion-Air Intake: Water heaters shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the water heater and the outdoors.

4. The minimum sealed combustion air duct size for each water heater is four-inch diameter.

5. Common Vent and Common Combustion Air must be an available option for water heater installation. Consult manufacturer for common vent and combustion air sizing.

6. Provide wall or roof termination kits as required for installation per manufacturer’s recommendations.

7. Follow guidelines specified in manufacturer’s venting guide.

J. Provide all condensing water heaters with an approved condensate neutralization kit.

2.03 COMPRESSION TANKS

A. Description: Steel, pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

B. Construction:

1. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.

2. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.

3. Air-Charging Valve: Factory installed.

C. Capacity and Characteristics unless otherwise indicated on the drawings.

1. Working-Pressure Rating: 150 psig.

2. Capacity Acceptable: 4 gal. minimum.

3. Air Precharge Pressure: 60 psig.

2.04 WATER HEATER ACCESSORIES

A. Gas Shutoff Valves: ANSI Z21.15/CGA 9.1, manually operated. Furnish for installation in piping.

B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.

1. Gas Water Heaters: ANSI Z21.22/CSA 4.4.

F. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.05 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3: EXECUTION

3.01 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases. Concrete base construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. 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.

C. Install gas water heaters according to NFPA 54.

D. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

E. Connect gas piping to water heater gas-train inlet with unions. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

G. Provide emergency water heater shut-off switch at the door for each room with water heater installed. Interlock water heaters to emergency shut-off switch. Verify exact location of emergency shut-off switch with local authority.

H. 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.

I. 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.

J. 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 "Domestic Water Piping Specialties" for hose-end drain valves.

K. Install thermometer on outlet piping of water heaters. Refer to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

L. Assemble and install inlet and outlet piping manifold kits for multiple water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each water heater. Include shutoff valve and thermometer in each water heater inlet and outlet, and throttling valve in each water heater outlet. Refer to Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty valves and to Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.

M. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

N. Connect hot-water piping to supply and return water heater tappings with shutoff valve and union or flange at each connection.

O. Multiple heaters shall be piped in reverse return or provided with balancing valves on hot water outlet. Each water heater shall have individual isolation valves for servicing and a hot water hose connection for start-up and field testing.

P. Fill water heaters with water.

Q. Charge compression tanks with air.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

3.03 FIELD QUALITY CONTROL

A. 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.

B. Tests and Inspections (Tank-Type)

1. Installation and Startup Test: Perform installation and startup checks according to manufacturer’s written instructions.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested or within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

E. Performance Tests

The water heater manufacturer is expected to provide partial load thermal efficiency curves. These thermal efficiency curves must include at least three separate curves at various BTU input levels. If these curves are not available, it is the responsibility of the water heater manufacturer to complete the following performance tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

2. Water heaters shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.

3. Perform field performance tests to determine capacity and efficiency of water heaters.

   a. Test for full capacity.
   b. Test for water heater efficiency at [low fire, 20, 40, 60, 80, 100, 80, 60, 40 and 20] percent of full capacity. Determine efficiency at each test point.

4. Repeat tests until results comply with requirements indicated.

5. Provide analysis equipment required to determine performance.

6. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

7. Notify Architect and Engineer in advance of test dates.

8. Document test results in a report and submit to Architect and Engineer.

F. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 22 34 00

SECTION 22 40 00

PLUMBING FIXTURES

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 22 05 00 for additional equipment and project requirements

1.02 SUMMARY

A. This Section includes:

1. Water closets
2. Urinals
3. Flush valves
4. Shower mixing valve assemblies
5. Lavatories
6. Stainless steel sinks
7. Faucets
8. Drains
9. Wastes
10. Service sinks
11. Laundry sinks
12. Service receptors
13. Drinking fountains
14. Water coolers
15. Eye/face wash
16. Emergency showers
17. Mixing valves
18. Wall hydrants
19. Supplies with angle stops
20. Fixture by others

B. Related Sections include the following:

1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

C. Products installed but not furnished under this Section include:
1. Owner-supplied fixtures, as indicated.
2. Accessories, appliances, appurtenances, and equipment specified in other sections, requiring plumbing services or fixture- related devices, as indicated.

1.03 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.

I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.04 SUBMITTALS

A. Refer to specification section 22 05 00 for additional requirements.

B. Product data for each type of plumbing fixture specified, including fixture and trim, fittings, accessories, appliances, appurtenances, equipment, supports, construction details, dimensions of components, and finishes.

C. Wiring diagrams for field-installed wiring of electrically operated units.

D. Color Charts

E. Operation and Maintenance Data: For plumbing fixtures to includes emergency operation and maintenance manuals.

1.05 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.

2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 2 of each type.

4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

5. Flushometer Tank, Repair Kits: Equal to 5 percent of amount of each type installed, but no fewer than 2 of each type.

6. Water-Closet Tank, Repair Kits: Equal to 5 percent of amount of each type installed.

7. Toilet Seats: Equal to 5 percent of amount of each type installed.

1.06 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities" as required by State Code for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Lead Free Requirements: All plumbing pipes, fittings, valves, fixtures, and other components in systems providing water for human consumption shall be 'lead-free' in accordance with the "Reduction of Lead in Drinking Water Act" and the "Safe Drinking Water Act", where the term 'lead-free' is defined to mean – "not containing more than 0.2 percent lead when used with respect to solder and flux; and not more than a weighted average of 0.25 percent lead when used with respect to the wetted surfaces of pipes, pipe fittings, plumbing fittings, and fixtures."

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with the following applicable standards and other requirements specified for plumbing fixtures:

1. Enameled, Cast-Iron Fixtures: ASME A112.19.1M.
2. Plastic Laundry Trays: ANSI Z124.6.
3. Plastic Mop-Service Basins: ANSI Z124.6.
4. Plastic Shower Enclosures: ANSI Z124.2.
5. Stainless-Steel Commercial, Handwash Sinks: NSF 2 construction.
6. Vitreous-China Fixtures: ASME A112.19.2M.
7. Water-Closet, Flush Valve, Tank Trim: ASME A112.19.5.
8. Water-Closet, Flushometer Tank Trim: ASSE 1037.

I. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:

1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.
2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
4. Faucets: ASME A112.18.1.
5. Hose-Connection Vacuum Breakers: ASSE 1011.
6. Hose-Coupling Threads: ASME B1.20.7.
7. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
8. NSF Potable-Water Materials: NSF 61.
9. Pipe Threads: ASME B1.20.1.
10. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
11. Supply Fittings: ASME A112.18.1.
12. Brass Waste Fittings: ASME A112.18.2.

J. Comply with the following applicable standards and other requirements specified for shower faucets:

1. Backflow Protection Devices for Hand-Held Showers: ASME A112.18.3M.
2. Combination, Pressure-Equalizing and Thermostatic-Control Antiscald Faucets: ASSE 1016.
3. Deck-Mounted Bath/Shower Transfer Valves: ASME 18.7.
4. Faucets: ASME A112.18.1.
5. Hand-Held Showers: ASSE 1014.
6. High-Temperature-Limit Controls for Thermal-Shock-Preventing Devices: ASTM F 445.
7. Hose-Coupling Threads: ASME B1.20.7.
8. Manual-Control Antiscald Faucets: ASTM F 444.
9. Pipe Threads: ASME B1.20.1.
10. Pressure-Equalizing-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.
11. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
12. Thermostatic-Control Antiscald Faucets: ASTM F 444 and ASSE 1016.

K. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Dishwasher Air-Gap Fittings: ASSE 1021.
4. Manual-Operation Flushometers: ASSE 1037.
5. Plastic Tubular Fittings: ASTM F 409.
6. Brass Waste Fittings: ASME A112.18.2.
7. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

L. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Shower Receptors: ANSI Z124.2.
8. Plastic Toilet Seats: ANSI Z124.5.
9. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.07 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Commercial Applications: One year from date of Substantial Completion.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver plumbing fixtures in manufacturer's protective packing, crating, and covering.

B. Store plumbing fixtures on elevated platforms in a dry location.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following for each fixture type or component listed.

1. Vitreous China Fixtures:

    a. American Standard
    b. Sloan
    c. Kohler
    d. Zurn

2. Stainless Steel Counter Sinks:

    a. Elkay
    b. Just

3. Flushometer:

    a. Sloan Royal
    b. Zurn Aquavantage
    c. American Standard

4. Faucets:

    a. Chicago
    b. Delta
    c. Zurn Aqua Spec
    d. American Standard

5. Wash Fountain:

    a. Bradley
    b. Acorn
    c. Sloan

6. Mop Basin/Utility Sink:

    a. Fiat
    b. Stern-Williams
    c. Mustee
    d. Acorn
    e. Zurn

7. Water Cooler:

    a. Oasis
    b. Sunroc
    c. Halsey-Taylor
    d. Elkay

8. Drinking Fountain

    a. Oasis
    b. Sunroc
    c. Halsey-Taylor

d. Elkay
e. Acorn Auqua

9. Enameled Cast Iron Fixtures:

a. American Standard
b. Sloan
c. Kohler
d. Zurn One

10. Emergency Fixtures:

a. Chicago
b. Bradley
c. Western Emergency Equipment
d. Haws

11. ADA Trap Wrap:

a. Truebro
b. Handi Lav-Guard
c. Brocer Products
d. Trap Wrap
e. Pro Wrap
f. Zurn

12. Toilet Seats:

a. Church
b. Bereke
c. Olsonite
d. Sperzel
e. Centoco

13. Plumbing Supports:

a. Josam
b. Wade
c. Smith
d. Zurn
e. Watts

14. Mixing Valves:

a. Delta Commercial
b. Symmons
c. Powers
d. Leonard
e. Lawler
f. Haws

15. Traps and Supplies

a. Zurn Traps and Supplies
b. Chicago

c. Brass Craft
d. Central
e. Royal
f. Dearborn
g. T&S

2.02 PLUMBING FIXTURES, GENERAL

A. Provide plumbing fixtures and trim, fittings, other components, and supports as specified in "Plumbing Fixture Data Sheets" at the end of Part 3 of this Section.

2.03 FAUCETS

A. Faucets General: Unless otherwise indicated, provide faucets that are cast brass with polished, heavy chrome-plate finish conforming to ASME A-112.18.1M. Lead content shall be less than 0.25%.

2.04 FITTINGS, EXCEPT FAUCETS

A. Fittings General: Unless otherwise specified, provide fitting fabricated of brass, with polished heavy chrome plate finish.

B. Escutcheons: Wall flange with set screw or sheet steel wall flange with friction clips, of depth adequate to conceal protruding roughing-in fittings.

2.05 SUPPLIES WITH ANGLE STOPS

A. Construction: Polished chrome plated, precision-machined brass ball, one-piece brass body construction, blow-out proof brass stem. Plastic stems are not allowed. Lead content shall be less than 0.25%.

B. Cartridge: Slow compression, renewable cartridges designed to close with water pressure.

C. Supply Riser: 3/8” O.D. x 12” flexible copper, chrome plated supply riser.

D. Handle: Removable, chrome plated, 2 ¼” metal loose key tee.

E. Escutcheon: Chrome plated metal wall flange.

F. Performance:

1. 20-125 psi rated operating pressure.
2. 40-140°F rated operating temperature.

G. Codes: ASME A112.18.1M.

2.06 FLUSHOMETERS

A. Provide flushometers compatible with fixtures, with features and of consumption indicated.

B. Construction: Cast-brass body, brass or copper pipe or tubing inlet with wall flange and tailpiece with spud, screwdriver check stop, vacuum breaker, and brass lever handle actuation except where other variations are specified. Type shall be diaphragm operation except where other type is specified.

C. Finish: Exposed metal parts shall be polished chrome-plated, except components installed in a concealed location may be rough brass or unfinished.

D. The mechanical contractor shall verify all mounting heights and water/waste rough-in locations with architectural elevations prior to ordering equipment and/or installation. The contractor shall verify mounting requirements and clearances of flushometers with architectural grab bar locations. The contractor shall modify all mounting elevations as required to allow for installation of all grab bars and ADA requirements.

E. Water Closet Flushometers: Furnish with the following features.

1. Non-hold-open feature.
2. Screw driver angle stop with seat bumper and cap.
3. Metal oscillating handle actuation.
4. Wall and spud flanges.
5. Adjustable tailpiece.
6. Vacuum breaker connection.
7. Furnish flushometers with factory-set, field-adjustable water consumption per cycle:

    a. Consumption: 1.6 gallons per flushing cycle.

F. Urinal Flushometers: Furnish with the following features.

1. Non-hold-open feature.
2. Screw driver angle stop with cap.
3. Metal oscillating handle actuation.
4. Wall and spud flanges.
5. Adjustable tailpiece.
6. Vacuum breaker connection.
7. Furnish flushometers with factory-set, field-adjustable water consumption per cycle:

    a. Consumption: 1.0 gallons per flushing cycle.

2.07 TOILET SEATS

A. General: Provide toilet seats compatible with water closets, and of type, color, and features indicated.

B. Toilet Seats: Heavy-duty, commercial/industrial type, elongated, open front, solid plastic, with self-sustaining check hinge, less cover.

2.08 WATER FILTER FOR WATER COOLERS

A. Capacity of 3000 gallons, 1.5 GPM, 105 psi. Conform to NSF/ANSI 42 and 53 for chlorine taste, odor, particulate Class 1 and lead reduction. Filter shall be integral to water cooler and installed in the factory.

2.09 PLUMBING FIXTURE SUPPORTS

A. Supports: ASME A112.6.1M, categories and types as required for wall-hanging fixtures specified, and wall reinforcement.

B. Support categories are:

1. Carriers: Supports for wall-hanging water closets and fixtures supported from wall construction. Water closet carriers shall have an additional faceplate and coupling when used for wide pipe spaces. Provide tiling frame or setting gage with carriers for wall-hanging water closets. Long barrel in vertical applications.

2. Chair Carriers: Supports with steel pipe uprights for wall- hanging fixtures. Urinal chair carriers shall have bottom bearing plates.

3. Chair Carriers, Heavy Duty: Supports with rectangular steel uprights for wall-hanging fixtures.

4. Reinforcement: 2-inch by 4-inch wood blocking between studs or 1/4-inch by 6-inch steel plates attached to studs, in wall construction, to secure floor-mounted and special fixtures to wall.

C. Support Types: Provide support of category specified, of type having features required to match fixture.

D. Provide supports specified as part of fixture description, in lieu of category and type requirements above.

E. Subject to compliance with requirements, provide plumbing fixture supports from one of the following:

1. Josam Mfg. Co.
2. Smith (Jay R.) Mfg. Co.
3. Wade; Subs of Tyler Pipe Corp.
4. Zurn Industries; Hydromechanics Division
5. Watts Drainage

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine roughing-in for potable cold water and hot water supplies and soil, waste, and vent piping systems to verify actual locations of piping connections prior to installing fixtures.

B. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 APPLICATION

A. Install plumbing fixtures and specified components, in accordance with designations and locations indicated on Drawings.

B. Install supports for plumbing fixtures in accordance with categories indicated, and of type required:

1. Carriers for following fixtures:

a. Wall-hanging water closets.
b. Wall-hanging fixtures supported from wall construction.

2. Chair carriers for the following fixtures:

a. Wall-hanging urinals.
b. Wall-hanging lavatories and sinks.
c. Wall-hanging drinking fountains and electric water coolers.

3. Heavy-duty chair carriers for the following fixtures:

a. Accessible lavatories.
b. Fixtures where specified.

4. Reinforcement for the following fixtures:

a. Floor-mounted lavatories required to be secured to wall.

b. Floor-mounted sinks required to be secured to wall.
c. Recessed, box-mounted drinking fountains and water coolers.

3.03 INSTALLATION OF PLUMBING FIXTURES

A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturers' written installation instructions, roughing- in drawings, and referenced standards.

B. Install floor-mounted, floor-outlet water closets with closet flanges and gasket seals.

C. Install floor-mounted, back-outlet water closets with fittings and gasket seals.

D. Install wall-hanging, back-outlet water closets with support manufacturer's tiling frame or setting gage.

E. Install wall-hanging, back-outlet urinals with gasket seals.

F. Fasten wall-hanging plumbing fixtures securely to supports attached to building substrate when supports are specified, and to building wall construction where no support is indicated.

G. Fasten floor-mounted fixtures and special fixtures having holes for securing fixture to wall construction, to reinforcement built into walls.

H. Fasten wall-mounted fittings to reinforcement built into walls.

I. Fasten counter-mounting-type plumbing fixtures to casework.

J. Secure supplies behind wall or within wall pipe space, providing rigid installation.

K. Set shower receptors and mop basins in leveling bed of cement grout.

L. Install stop valve in an accessible location in each water supply to each fixture.

M. Install “cleanable” trap on fixture outlet except for fixtures having integral trap.

N. All fixtures traps exposed shall be Adjustable “P” chrome plated brass trap.

O. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished locations and within cabinets and millwork. Use deep pattern escutcheons where required to conceal protruding pipe fittings.

P. Seal fixtures to walls, floors, and counters using a sanitary-type, one-part, mildew-resistant, silicone sealant in accordance with sealing requirements specified in Division 7. Match sealant color to fixture color.

Q. The mechanical contractor shall verify all mounting heights and water/waste rough-in locations with architectural elevations prior to ordering equipment and/or installation. The contractor shall verify mounting requirements and clearances of flushometers with architectural grab bar locations. The contractor shall modify all mounting elevations as required to allow for installation of all grab bars and ADA requirements.

R. Provide insulation kit equal to Truebro Inc. model # 102 Handi-Lav Guard insulation for all exposed hot and cold water and waste piping and fittings.

3.04 CONNECTIONS

A. Piping installation requirements are specified in other sections of Division 22 and 23. The Drawings indicate general arrangement of piping, fittings, and specialties. The following are specific connection requirements:

1. Install piping connections between plumbing fixtures and piping systems and plumbing equipment specified in other sections of Division 22 and 23.

2. Install piping connections indicated between appliances and equipment specified in other sections, direct connected to plumbing piping systems.

3.05 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning fixtures and components, then retest. Repeat procedure until all units operate properly.

3.06 ADJUSTING AND CLEANING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers, hot water dispensers, and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at drinking fountains, electric water coolers, and faucets, shower valves, and flushometers having controls, to provide proper flow and stream.

D. Replace washers or cartridges of leaking and dripping faucets and stops.

E. Clean fixtures, fittings, and spout and drain strainers with manufacturers' recommended cleaning methods and materials.

F. Review the data in Operating and Maintenance Manuals. Refer to Division 1 Section "Project Closeout."

3.07 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of fixtures for temporary facilities, except when approved in writing by the Owner.

C. Protect interceptors during construction period, to avoid clogging with construction materials and debris, and to prevent damage from construction debris and traffic.

3.08 PLUMBING FIXTURE SCHEDULE

A. Item WC-1 – Water Closet (Wall Hung, Manual Flush Valve, ADA Compliant)

1) Fixture: American Standard #2257.101 “Afwall” elongated water saver water closet, white vitreous china, siphon jet action, 1 ½” top spud, 1.6 GPF. Provide concealed toilet carrier.

2) Seat: American Standard #5901.100SS solid plastic, open front with self-sustaining hinge for elongated bowl, white.

3) Flush valve: Sloan Royal Model 111-1.6 low consumption flushometer chrome plated brass construction, ADA compliant handle, 1.6 GPF.

B. Item UR-1 – Urinal (Wall Hung, Manual Operated Flush Valve, ADA Compliant)

1) Fixture: American Standard #6561.017 “Trimbrook” 1.0 GPH, white vitreous china, siphon jet, flushing rim, extended stall sides, ¾” inlet top spud, 2” back outlet, supporting bolts.

Mount fixture at ADA compliant height.

2) Flush valve: Sloan Royal Model 186-1 low consumption flushometer chrome plated brass construction, ADA compliant handle, 1.0 GPF.

C. Item LAV-1 – Wall Hung Lavatory (Battery Operated Faucet, ADA Compliant)

1) Fixture: American Standard #0355.012 "Lucerne" wall hung white vitreous china lavatory, 18-1/4" x 20-1/2", faucet holes on 4-inch centers, front overflow, concealed arms support.

2) Faucet: American Standard #6053.202 "Innsbrook Selectronic" chrome plated faucet with aerator.

3) Accessories: Provide 4-inch lavatory waste tailpiece, 1 ¼-inch diameter chrome plated grid strainer, chrome plated cast brass trap with cleanout plug and drain tubing with wall flange, ½-inch chrome plated angle valves and flex risers with wall flanges, supply and drain ADA insulation wrap. Provide Selectronic Thermostatic Mixing Valve 605XTMV1070.

D. Item SK-1 – Counter Set Double Bowl Sink w/ Gooseneck Faucet (33" x 19-1/2" x 6-1/2", Manual Trim, ADA Compliant)

1) Fixture: Elkay LRAD331965, 33"x 19-1/2" x 6-1/2" D, type 304 stainless steel, 18 gauge, self-rimming, 3 ½-inch diameter outlet, mounting hardware.

2) Faucet: Chicago Faucets #201-G8AE3-317AB chrome plated gooseneck faucet swing spout with wristblade handles and aerator.

3) Accessories: Provide 4-inch lavatory waste tailpiece, 1 ¼-inch diameter chrome plated grid strainer, chrome plated cast brass trap with cleanout plug and drain tubing with wall flange, ½-inch chrome plated angle valves and flex risers with wall flanges, supply and drain ADA insulation wrap.

E. Item SK-2 – Utility Sink

1) Fixture: Fiat Serv-A-Sink Model FL-1 molded stone with baked enamel legs.

2) Accessories: Chicago Faucets #891-ABCP deck mounted, chrome plated brass faucet, 4" centers with swing spout.

F. Item MS-1 – Mop Basin Service Sink (Floor Mount)

1) Fixture: Fiat MSB 2424, 24" x 24" x 10" high, molded stone floor receptor, 3" grid strainer, stainless steel rim guards. Provide wall splash guard for two or three walls as applicable.

2) Trim: Chicago Faucets #897-CP chrome plated brass wall mounted faucet with vacuum breaker, integral stops, adjustable wall brace, pail hook, ¾" threaded hose spout, body inlets on 8" centers.

3) Waste: Removable chrome plated brass grid strainer for 3" drain pipe.

4) Accessories: Hose and bracket, Fiat Model 832AA, 30" long flexible, heavy duty 5/8" rubber hose, and mop hanger, Fiat Model 889-CC.

G. Item HB-1 – Hose Bibb

1) Fixture: Chicago Faucets #952-CP, rough chrome plated, 3/4" hose connection, atmospheric vacuum breaker.

H. Item HB-2 – Hot and Cold Interior Hose Bibb

3) Fixture: Chicago Faucets #305-VBLEARCF chrome plated brass wall mounted faucet with atmospheric vacuum breaker, integral stops, ¾" threaded hose spout.

I. Item WH-1 – Exterior Wall Hydrant

1) Fixture: Woodford Model B65, Flush mounted wall box, freezeless, 34HA field testable vacuum breaker, loose key operated. Chrome finish.

J. Item EWSH-1 – Emergency Eyewash/ Shower Unit

1) Fixture: Bradley Model S19314BF. Combination drench shower and eye/face wash unit, shall meet ANSI Standard Z358.1.

2) Drain: Provide drain connection to floor drain.

3) Accessories: Provide Lawler emergency fixture thermostatic mixing valve model 911E.

K. Item EWC-1 – Electric Water Cooler (Dual Height Unit w/ Bottle Filler, ADA Compliant)

1) Fixture: Elkay Model LZSTL8WSSK, ADA Compliant dual level wall mounted split-level electric water cooler with stainless steel cabinet and contoured basin, flexible bubbler to prevent accidental injuries; front and side push button operation, and an inline flow regulator. Cooling system shall be in cabinet and shall include a fin and tube type condenser with 4.3 watt permanently sealed and lubricated fan, 1/2 HP, R-134a compressor, with thermal overload protection, to cool 8 gallons per hour, with 90 degree ambient air, of water from 80 to 50 degrees F. Bottle filling unit shall include an electric sensor for touchless activation with automatic 20 second shut off. Bottle filler shall provide 1.1 – 1.5 gpm flow rate with laminar flow. Unit shall be assembled with lead free components. Provide mounting hardware. Refer to Architectural drawings for mounting height.

2) Waste: Removable, chrome plated brass strainer, 1 ¼" O.D. trap connection with 1 ¼" tailpiece.

3) Trap: Adjustable "P" chrome plated brass trap with 1 ½" 17 gauge tubing, drain to wall, ground swivel joints, clean-out, wall flange. Trap is to be concealed within cabinet.

4) Supply: 3/8" I.P.S. connection with 3/8" chrome plated angle valve with loose key stop and 3/8" copper flexible tube riser.

L. Item SH-1 – Shower Enclosure, Head, Handle & Hose (ADA Compliant)

1) Shower: Symmons Temptrol packaged shower unit Model C-96-500-B30-Vwith chrome plated brass pressure-balancing valve, adjustable stop screw to limit handle turn, flow diverter with integral volume control, wall mount shower head with arm and flange, wall/hand shower head with 72" chrome plated flexible metal hose, 48" chrome plated wall mounted slide bar and wall connection. Mount at ADA compliant height.

2) Enclosure: Freedom Showers ADA roll in shower model APFQ3682BF75L, 36"x36" barrier free.

3) Options: Grab bars, folding shower seat, shower drain.

M. Item UB-1 – Refrigerator Water Outlet Box

1) Fixture: Guy Gray Model BIM875AB Galvanized Outlet Box, 20 gauge G90 hot dipped galvanized steel construction, and shut-off valve. Provide ASSE 1022 listed backflow preventer.

2) See Architectural Elevations for mounting height.

N. Item UB-2 – Washing Machine Outlet Box

1) Fixture: Guy Gray Model FB200 Washing Machine Outlet Box, 20 gauge G90 hot dipped galvanized steel construction, hot and cold water shut-off valves, 2-inch threaded drain fitting. Provide ASSE 1021 or IAPMO PS23-2006a listed air gap fitting for waste discharge. Provide ASSE 1001, ASSE 1020, or ASSE 1056 listed backflow preventer for water supply connection.

2) See Architectural Elevations for mounting height.

END OF SECTION 22 40 00

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

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. Coordination
2. Interpretation of Plans
3. Coordination Drawings.
4. Cost Breakdown
5. Substitutions and Prior Approval Requests
6. Record Documents
7. Maintenance Manuals
8. Fire Safety Precautions
9. Personal Safety Requirements
10. Testing, Adjusting and Balancing
11. Equipment Rebates
12. Renovation Projects
13. Temporary Heat/Equipment Operation
14. Piping materials and installation instructions common to most piping systems.
15. Equipment installation requirements common to equipment sections.
16. Painting and finishing.
17. Concrete bases.
18. Supports and anchorages.

1.03 GENERAL

A. This Section includes mechanical items common to all of this division specification sections.

B. Provide services, skilled and common labor, and all apparatus and materials required for the complete installation as shown and within the intent of the contract documents, field conditions, and code requirements.

C. The intention of these Contract Documents is to call for finished work, fully tested and ready for operation. Any components or labor not mentioned in the Contract Documents but required for functioning systems shall be provided. Should there appear to be any discrepancies or questions of intent, the Contractor shall refer the matter to the Architect/Engineer for decision before start of any related work.

D. The drawings show the general arrangement of systems and equipment but do not show all required fittings and offsets that may be necessary to connect pipes and ductwork to equipment, and to coordinate with other trades. Provide all necessary fittings, offsets and runs based on field measurements and at no additional cost. Coordinate with other trades for space available and relative location of equipment and accessories. Pipe and duct location on the drawings shall be altered by contractor where necessary to avoid interferences and clearance difficulties.

E. This contractor will be responsible to carry out the commissioning requirements specified. Refer to Division 1 for additional requirements.

1.04 DESCRIPTION

A. These Division 23 specifications define the statutory, administrative, procedural, and technical requirements of the mechanical and controls modifications, replacements, and/or upgrades products and services to be provided on this Subcontract.

B. Provide HVAC work as indicated on the Drawings and specified in Division 23 including:
   1. Prepare coordination drawings, shop drawings, submittals, as-built drawings, and operating and maintenance instructions.
   2. Determine items and quantities required.
   3. Provide complete, continuous, operational, and functioning systems.
   4. Fully coordinate with work of other Sections, including field verification of elevations, dimensions, clearance, and access.
   5. Repair of all damage done to premises as a result of this installation and removal of debris left by those engaged in this installation.
   6. Rigging, hoisting, transportation, and associated work necessary for placement of equipment in the final location shown.
   7. Disassembly and re-assembly of equipment furnished under this Section, should this be required in order to move equipment into final location shown on the Drawings.
   8. Labor, materials, tools, appliances and equipment that are required to furnish and install the complete installation for this section of the work including that which is reasonably inferred.
   9. Cooperation with other crafts in putting the installation in place at a time when space required is accessible.
   10. Temporary scaffolding necessary for performance of the work in this Division.
   11. Cutting and core drilling required for work of Division 23, including locating of rebar or coordination of locating rebar with the General Contractor.
   12. Pipe sleeves for all holes in walls, floors, and ceilings, and cutting of floor slabs and slabs on grade.
   13. Waterproofing where necessary for installation under this Division.
   14. Cooperation with and assistance to the Facilities Monitoring and Control System Contractor as required to provide a complete and functional HVAC system.
   15. Counterflashing of roof penetrations for work of Division 23.
   16. Sizes, and locations for installation of any curbs and pads for work of Division 23.
   17. Temporary and permanent stands and supports for equipment requiring them including vibration isolation.
   18. Temporary protection of existing installation.
   19. Stenciling and equipment identification.
   20. Firestopping of penetrations of ducts, piping, and conduits through walls, floors, and ceiling assemblies.
   21. Temporary utilities as required to install work on Division 23 including lighting, water, gas, electricity, etc.
   22. Fees, permits, inspections, taxes, and approach from agencies that have jurisdiction over installation of Division 23.
   23. Air and water balancing.
   24. Participation in and coordination with the Commissioning process.
   25. Warranty.

1.05 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.06 WARRANTY

A. Provide guarantee and maintain the stability of workmanship and materials used and keep same in good operating condition for a period of minimum or one year after final completion of the work (unless specified otherwise) as evidenced by the issuance of the final certificate by the Architect.

B. Correct any deficiencies/defects of any kind immediately and; at the Contractors expense due to faulty workmanship or materials that arise during the above mentioned period of time. Corrections shall be done to the satisfaction of the Engineer/Architect. Such reconstruction and/or repairs shall include damages to the finishes or the building resulting from the original defect.

1.07 COORDINATION

A. Coordinate mechanical work with that of other trades in order to:

1. Avoid interferences between general construction, mechanical, electrical, structural and other specialty trades.
2. Maintain clearances and advise other trades of clearance requirements for operation, repair, removal and testing of mechanical equipment.
3. Indicate aisle-ways and access-ways required on coordinated shop drawings for roof equipment area, mechanical equipment rooms, data and telecomm rooms, corridors, ceiling spaces, shafts, corridors, ceiling space, laboratories, etc.

B. Understanding of Work:

1. Study, examine, and compare of the contract documents, including drawings and specifications. The Subcontractor shall have a full understanding of how the work in this part is scheduled, phased, and installed with work of other trades.
2. Include in this installation piping, ductwork, devices, and equipment that are necessary for complete and operating systems as specified and as required.
3. Connect piping and ductwork from fixtures, outlets, and devices full size to the nearest suitable main or riser.
4. Certain installations may be presented as typical, and full details are not repeated for each case. Subcontractor shall provide complete installation as if full details apply to each and every case, and make adjustments to typical details to suit each specific installation as part of the basic work.
5. Installation of work presented on the diagrams are applicable to the plans, and work depicted on the plans are applicable to the diagrams.
6. If there is a discrepancy in the drawings or specifications, the contractor shall figure the work based on the most stringent requirements to complete the installation and obtain clarification from the Architect before installation.

C. Sequence, coordinate, and integrate the various elements of mechanical systems, materials, and equipment. Comply with the following requirements:

1. Coordinate mechanical systems, equipment, and materials installation with other building components.
2. Verify dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for mechanical installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible. Work shall be above ceilings or ceiling line.

7. Coordinate installation and connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service.
8. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Coordinate with individual system requirements.
9. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
10. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as is practical, connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.
11. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope.
12. Coordinate with the locations of electrical panels and avoid installing piping and ductwork over them. Electrical panels are purposely located and have priority for location. The contractor is responsible for required piping and ductwork offsets to insure that the panels are located as designed and for other conditions.
13. Perform system modification recommended by Test and Balance Agency after recommendations are accepted by the Engineer

1.08 INTERPRETATION OF PLANS

A. In general, the Drawings are to scale. However, to determine exact locations of walls and partitions, the Contractor shall consult the architectural and/or structural Drawings which are dimensioned. Drawings shall not take precedence over field measurements.

B. Drawings are diagrammatic only. They are intended to indicate size and/or capacity where stipulated, approximate location and/or direction, and approximate general arrangement of one phase of work to another, but not the exact detail of construction. All work shall be constructed from field measurements taken at the site. This shall include all rises, drops, elbows, offsets, etc as necessary to avoid structural members or equipment and materials installed by other trades. The contractor shall coordinate the ductwork and piping layout before construction. No additional costs will be allowed for piping and ductwork fabrications without field verification of available space. If it is found, before installation, that a more convenient, suitable or workable arrangement of any or all phases of construction would result by altering the arrangement indicated on the Drawings, the architect/engineer may require the contractor to change the arrangement of his work without additional cost to the owner.

C. The drawings and specifications are intended to supplement each other. Any items shown on the drawings and not mentioned in the specifications, or vice versa, shall be executed the same as if mentioned and shown.

D. The greatest quantity or more expensive work shall govern where there is a conflict noted anywhere on the drawings and/or specifications.

1.09 COST BREAKDOWN

A. Submit a cost breakdown for each claim according to General Conditions of the Contract. Include project name, location, Architect/Engineer, Contractor and date.

1. List the cost breakdown for labor and material separately and include a total.

2. Breakout and detail the cost according to specification sections.

1.10 SUBSTITUTIONS AND PRIOR APPROVAL REQUESTS

A. Equipment manufacturers where indicated on the drawings are the basis of design. The contractor accepts responsibility for all design implications when providing approved equipment other than the design basis.

B. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics than the basis of design may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at the cost of the contractor. If minimum energy rating or efficiencies are specified, equipment shall comply with those requirements. Cost implications to other trades are the responsibility of the contractor.

C. Dimensional and Wight Changes: Substituted equipment with dimensions or weight different than the basis of design may be furnished provided such proposed equipment is approved in writing. The contractor is responsible for verifying and coordinating proposed equipment such that it maintains the design intent for access and serviceability and reserves space for future equipment where required. Cost implications to other trades are the responsibility of the contractor.

D. Bids shall be based on the exact materials specified, those listed scheduled on the drawings, or on materials which have been accepted as equivalent. The specified/scheduled products have been used in the design of the project and the preparation of the drawings and specifications as such establish minimum standards of function, dimension, appearance and quality necessary and requisite for this project, which substitutes must meet to be considered acceptable. The burden of proof of equality rests with the party making the request.

E. Requests for substitution shall be in writing and shall be received by the Engineer not later than 10 days before bid opening date. Materials not specified or accepted as equivalent shall not be acceptable for installation.

F. Each prior approval request for substitution shall include and meet the following requirements:

1. The name and model of the material or equipment for which an equivalent is being proposed and a complete description of the proposed equivalent including drawings, cuts sheets, equipment performance capacity and test data, equipment weights, electrical and any other information necessary for a complete evaluation.

2. A written comparison listing any deviations from the scheduled equipment and/or the specification requirements must also be provided prior to any proposed substitution will be evaluated.

3. A written statement setting forth any changes in other materials, equipment, electrical, structural and/or other Work in which incorporation of the equivalent may be required shall be included.

4. Material and/or equipment requests which do not meet the above requirements will not be evaluated or approved.

5. The burden of proof of the merit of the proposed equivalent is upon the proposer. Any and all extra costs associated with the equipment change and affecting architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the entity requesting the substitution.

6. The Engineer’s decision of approval or disapproval of a proposed equivalent is final.

G. Final approval of all equipment shall be contingent on shop drawing acceptance, compliance with the specifications and performance criteria as scheduled and acceptable installation. General approval to bid a product does not relieve the Supplier or Contractor of meeting specific specification requirements.

H. The Mechanical Contractor shall pay, provide, install and be responsible for extra materials required or any other trade due to this use of alternate accepted equipment which has installation requirements different than the specified equipment. The Mechanical Contractor shall pay other trades for any extra work they are involved in due to this substitution of equipment.

I. If substitutions of controls or equipment require any changes in the architectural, structural, mechanical, plumbing or electrical work from that shown on the drawings, the extra cost of the equipment or architectural, structural, mechanical, plumbing or electrical work shall be responsibility of the Contractor requesting the substitution. All substitutions shall be prior approved by the Architect or Engineer before purchase by the contractor.

J. Where any redesign of electrical, mechanical or other work is required due to substitution, arrangement or equipment layout other than herein specified or shown:

1. Arrange for required redesign by Architect and Engineer.
2. Pay all costs for such redesign.

1.11 SUBMITTALS

A. Refer to individual product and equipment specification sections for detailed submittal requirements.

B. The mechanical and electrical contractor shall have an onsite meeting prior to installation to review all shop drawings and verify all electrical requirements with the electrical contractor. The mechanical contractor shall be responsible for coordinating and setting up meeting and sharing of mechanical equipment electrical requirements with electrical contractor prior to when construction is set to begin and equipment is to be ordered.

C. The electrical contractor shall sign off on all mechanical shop drawings for electrical requirements prior to ordering equipment.

1.12 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section "Project Record Documents." In addition to the requirements specified in Division 1, at a minimum the contractors shall:

1. Maintain an on-site set of drawings to record actual revisions to the work being performed on site. Revisions shall be shown on the documents legibly to reflect actual on-site changes to the documents.
2. Revisions shall be show on the documents in a contrasting color (red).
3. Revisions shall be updated to the on-site plan daily.
4. Ensure all revisions and documentation is complete and accurate, enabling future reference by Owner.

B. Refer to specific sections for additional record documentation.

1.13 MAINTENANCE MANUALS

A. Prepare maintenance manuals in accordance with Division 1 Section "Operating, Maintenance, and Warranty Data". Submit copies for review by Architect/Engineer. In addition to the requirements specified in Division 1, include the following information:

1. Descriptive summary of function, normal system operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

2. Manufacturer's printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions.

3. Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

4. Servicing instructions and lubrication charts and schedules.

5. Warranty information for all mechanical items shall be included in one tabbed section.

1.14 FIRE SAFETY PRECAUTIONS

A. The Contractors shall exercise extreme care to maintain and exercise adequate fire safety precautions throughout the work. This shall include providing sufficient fire fighting devices, watchmen, standby helpers or other precautions during construction, in use of temporary heat, welding, brazing, sweating, testing or other phases of work.

B. At all times, access shall be maintained for fire department trucks to the building.

C. All welding brazing, cutting and sweating operations performed in vicinity of or accessible to combustible materials shall be adequately protected to make certain that sparks or hot slag does not reach the combustible material and start a fire.

D. All glass, glazed materials and other finish, in the vicinity of welding, brazing and cutting, shall be masked by the Contractor performing the welding work.

E. When necessary to do cutting, welding, brazing, sweating and similar work in vicinity of wood, in shafts, or vicinity of any combustible material (and the combustible material cannot be removed), the materials shall be adequately protected with fire resistant blankets or similar approved coverings. In addition, a helper shall be stationed nearby with proper fire extinguishers (provided by the Contractor performing the work) to guard against sparks and fire.

F. Whenever combustible materials have been exposed to sparks, molten metal, hot slag or splatter, a person shall be kept at the place of work to make sure the smoldering fires have not been started. Whenever cutting or welding operations are carried on in a vertical pipe shaft, a person to act as a fireguard shall be employed to examine all floors below the point of cutting or welding. This fireguard shall be kept on duty after completion of work to guard against fires and shall examine each level after this time, prior to leaving. There shall be no exceptions to this requirement and failure to comply will be construed as negligence.

1.15 PERSONAL SAFETY REQUIREMENTS

A. The Contractor shall be responsible for initiating, maintaining and supervising all safety precautions required in connection with his work, including regulations of the Occupational Safety and Health Administration (OSHA) and other governing agencies.

1.16 TESTING, ADJUSTING AND BALANCING

A. All mechanical systems will be balanced by an independent test and balance agency hired by the mechanical contractor. The scope of the testing and balancing work includes functional performance testing of all mechanical systems. Deficiency reports will be distributed directly to the contractor on an ongoing basis. Exceptions taken to specific direction issued by the testing agency shall be brought to the attention of the engineer by the installing contractor.

B. The Contractor shall be certain that all systems are ready for proper operation prior to balancing and adjusting with clean filter and other system elements, e.g., coils. Temperature control calibration, electrical interface, etc., shall also be complete prior to balancing and adjusting. All equipment shall be freshly oiled. The Contractor shall instruct his employees and subcontractors to leave all balancing devices in a wide open position and free all operating arms and adjustments so that they can be easily operated. The contractor shall write a letter to the testing agency indicating that each of the areas defined by the construction schedule is complete and ready for balancing.

C. The Contractor shall provide and coordinate the services of qualified, responsible subcontractors, suppliers and personnel as required to correct, repair, and/or replace any and all deficient items or conditions found during the course of this project, including the testing, adjusting, and balancing period.

D. In order that all systems may be properly tested, balanced, and adjusted as required herein by these Specifications, the Contractor shall operate the systems at his expense for the length of time necessary to properly verify their completion and readiness for TAB.

E. Project Contract completion schedules shall allow for sufficient time to permit the completion of TAB services prior to Owner occupancy. The Contractor shall allow adequate time for the testing and balancing activities of the Owner provided services, during the construction period, and prior to Substantial Completion as defined in the Uniform General Conditions of this Construction Document.

F. The Drawings and Specifications indicate valves, dampers, and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Contractor to install these devices in a manner that will leave them accessible and readily adjustable. Should any such device not be readily accessible, the Contractor shall provide access as requested by the TAB Firm. Also, any malfunction encountered by TAB personnel and reported to the Contractor shall be corrected by the Contractor immediately so that the balancing work can proceed with the minimum of delays.

G. Complete operational readiness of the HVAC systems also requires that the following be accomplished:

1. Distribution Systems:

a. Verify installation for conformity to design. All supply, return, and exhaust ducts shall be terminated and tested as required by the Specification.
b. Dampers shall be properly located and functional. Dampers shall have tight closure and open fully with smooth and free operation.
c. Supply, return, exhaust, and transfer grilles, registers, diffusers, and terminal devices shall be installed and secured in a full open position.
d. Air handling systems, units, and associated apparatus shall be sealed to eliminate uncontrolled bypass or leakage of air. Final clean filters shall be in place, coils shall be clean with fins straightened, bearings properly greased, and the system shall be completely operational. The Contractor shall verify that all systems are operating within the design pressure limits of the piping and ductwork.
e. Under normal operating conditions, check condensate drains for proper connections and functioning. Cooling coil drain pans have a positive slope to drain. Cooling coil condensate drain trap maintains an air seal.
f. Check for proper sealing of air-handling unit components.
g. Fans shall be operating and verified for freedom from vibration, proper fan rotation and belt tension; heater elements in motor starters to be of proper size and rating, as per the starter manufacturer; record motor amperage and voltage on each phase at start-up, and verify they do not exceed nameplate ratings.
h. Thermal overload protection is in place for fans and other equipment. Bearings shall be greased. Belts shall be aligned and tight
i. Terminal units shall be installed and functional (i.e. controls functioning).

H. Water Circulating Systems:

a. Verify installation for conformity to design. Hydronic systems are pressure tested, flushed, filled, and properly vented. Service and balance valves are fully open. Examine HVAC system and equipment installations to verify that indicated balancing devices are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation
b. All valves shall be set to their full open position. After the system is flushed and checked for proper operation, all strainers shall be removed and cleaned. The Contractor shall repeat the operation until circulating water is clean and then the start-up strainers shall be discarded. Bearings shall be greased.
c. Record pump motor amperage on each phase and voltage after reaching rated speed. Readings shall not exceed nameplate rating. Verify that the electrical heater elements are of the proper size and rating as per the starter manufacturer.
d. In preparation of TAB, water circulating systems shall be full and free of air, expansion tanks shall be set for proper water level, and all air vents shall be installed at high points of systems and operating freely. Chemicals shall be added to closed systems to treat piping and inhibit corrosion. The system static pressure shall be adequate to completely fill the system without operating the pumps.
e. Check and set operating parameters of the heat transfer and control devices to the design requirements.
f. Proper balancing devices shall be in place and located correctly. These devices include but are not limited to flow meters, pressure taps, thermometer wells, balancing valves, etc. Heat transfer coils shall be checked for correct piping connections.

I. Automation Controls

a. The BAS shall verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.
b. The BAS Contractor shall verify that all controlling instruments are calibrated and set for design operating conditions with the exception of components that require input from the TAB Agency, but a default shall be set. The Control Contractor shall cooperate with the TAB Agency and provide all software and interfaces to communicate with the system.
c. The BAS Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB Agency that the BAS is operational. The BAS Contractor shall provide technical support (technicians and necessary computers) to the TAB Agency for a complete check of these systems.
d. Prior to occupancy, each ventilation system shall be tested to ensure that OA dampers operate properly in accordance with system design.
e. Fire Alarm: Division 26 shall thoroughly check all detection devices, sequences, inter-locks, etc. before notifying the TAB Agency that the system is operational. Division 26 shall certify that the systems are totally operational to the Contract or prior to the TAB beginning.
    1) The BAS contractor and Fire Alarm contractor shall coordinate all fire and smoke dampers/sensors operation with the shutdown sequence with all air handling equipment.
    2) The Fire Alarm contractor shall be responsible for preparing final documentation of system integration:
    3) The contractors shall review the drawings and specifications. The contractors shall establish an initial sequence of operation and matrix for all integration of system, including fire alarm sequences, HVAC fan and equipment shutdown, fan operation, damper operation, door closings, door unlocking, exhaust/makeup air systems, etc.
    4) Review initial sequence of operation and matrix with mechanical and electrical engineer and owner to verify proposed system operation.
    5) Provide final sequence and matrix based on actual install conditions.

1.17 EQUIPMENT REBATES

A. The contractor shall be responsible for applying for and leading the rebate application process for all eligible equipment / systems within the project on behalf of the owner.

B. The contractor shall provide all receipts, invoicing, counts, site data, etc as required to procure equipment rebates

C. The contractor shall forward the filled out application and all necessary rebate “back-up” requirements to the owner at the completion of the project.

1.18 TEMPORARY HEAT/EQUIPMENT OPERATION

A. Provide temporary gas meter and connections to equipment provided by the General Contractor as required for temporary heat.

B. Warranties:

1. The Contractor shall provide extended warranties for all equipment and mechanical system components operated prior to the date of substantial completion. The Contractor shall obtain in writing from the manufacturer extended warranties for all equipment such that the Owner's warranty starts at the date of substantial completion in accordance with the General Division 1 requirements. Any additional costs shall be the burden of the Contractor.

C. Temporary Air Handling Equipment Operation:

1. Manually operate air-handling systems to provide suitable environment for installation of interior finishes. Provide factory start-up of all variable speed drives. Perform commissioning operations prior to starting units and operate the systems in accordance with the following procedures for manually operating the air handling

systems. The Contractor shall obtain in writing from the manufacturer extended warranties for all affected equipment. Any additional costs shall be the burden of the Contractor:

a. The air handling systems shall not be operated at outside air temperature below 40.0 degrees. Open outdoor air dampers, close return air dampers, open all air terminals to full open, install filters, ensure condensate drain is functioning and electrical protection devices are installed. Start fan, monitor indoor and outdoor conditions, and operate heating and cooling systems to control space conditions; shut down systems completely and close outdoor air dampers at end of each workday. Return/exhaust fans shall not run during temporary operation.

D. Temporary Boiler Operation:

1. The boiler and building hot water system shall not be used for temporary heat in the building. The boiler may be started prior to substantial completion only with written approval from the Owner. The boiler circulation loop, circulation pump, and controls must be installed.

2. The contractor must submit to the Engineer a phasing plan for bringing areas of the building and systems on line. The phasing plan must include time allotment to complete cleaning and flushing procedures as outlined in specification Section 15510. Prior to starting each phase, the contractor must document that all cleaning and flushing procedures have been completed. The contractor shall provide any additional piping, pumps, fittings, and power required such that any additional areas of piping added to the system are flushed and cleaned prior to circulating water from previously cleaned areas.

3. Provide start-up services for the boiler and all pump variable speed drives by an authorized factory representative. The contractor shall obtain in writing from the manufacturer, extended warranties for all affected equipment. Any additional cost shall be the burden of the contractor. The temperature control system shall be operational to trend the boiler circulation loop to ensure the boiler has been shock protected for the entire duration of the temporary service.

PART 2: PRODUCTS

2.01 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 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.

2.02 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:

1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:

1. EPDM: Ethylene-propylene-diene terpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

2.03 SUBMITTALS

A. Product Data: For the following:

1. Transition fittings.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Escutcheons.

B. Welding certificates.

2.04 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.

2.05 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.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

2.06 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. ABS Piping: ASTM D 2235.
2. CPVC Piping: ASTM F 493.
3. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
4. PVC to ABS Piping Transition: ASTM D 3138.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.07 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

B. Plastic-to-Metal Transition Fittings: One-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.

D. Plastic-to-Metal Transition Unions: MSS SP-107, four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.

E. 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.

2.08 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type

neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.09 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

2. Pressure Plates: Stainless steel. Include two for each sealing element.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.010 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

2.011 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. Provide with polished chrome plated finish.

2.012 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.

2.013 VIBRATION ISOLATION

A. All equipment shall be provided with adequate vibration isolation to prevent vibration and noise transmission to the building structure.

B. No rigid connections between equipment and building structure shall be made that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment shall be looped to allow free motion of isolated equipment.

C. Spring isolation shall be provided for all moving equipment as per plans and specifications. If no floor mounted spring isolation is required, equipment shall mount on neoprene elastomer in-shear vibration isolation pads and then anchored to the structure.

PART 3: EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

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.

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 fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors:

M. Sleeves are not required for core-drilled holes.

N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces.

    a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

    a. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.

b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

O. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.

2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

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.

R. Verify final equipment locations for roughing-in.

S. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 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. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. 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.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.03 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.

4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.04 ACCESS DOORS/PANELS IN GENERAL CONSTRUCTION

A. Size: 16" x 16" minimum where valves and similar related items are within easy reach of operator, and at least 24" x 24" when passage through opening is required to reach devices requiring maintenance and manual operation.

B. Construction: Hinged flush type steel frame panel, 14 gauge minimum for door and 16 gauge minimum for frame, and with anchor straps.

1. Border: Only narrow border exposed.
2. Hinges: Concealed type.
3. Locking device: Flush cam type and screwdriver operated.
4. Metal surfaces: Prime coat with rust-inhibitive paint.

C. Manufacturer: Milcor type by L. M. Walsh Company.

1. Gypsum Board Surfaces: Style DW with concealed spring hinges.
2. Masonry Surfaces: Style M, with masonry anchors.
3. Acoustical Tile Ceilings: Style AT with recessed pan to receive acoustical tile material.

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 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.

3.06 PAINTING

A. Painting of HVAC 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 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.

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."

3.08 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

C. Field Welding: Comply with AWS D1.1.

3.09 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.

B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.10 GROUTING

A. Mix and install grout for HVAC 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 23 05 00

SECTION 23 05 13

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.03 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:

1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2: PRODUCTS

2.01 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.02 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.03 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Separate winding for each speed.

E. Rotor: Random-wound, squirrel cage.

F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading. Sleeve type bearings permitted for fractional hp (less than ½ hp) light duty applications.

G. Temperature Rise: Match insulation rating.

H. Insulation: Class F.

I. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.

2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.04 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.

2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.

4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Efficiency: Motor efficiency shall meet or exceed efficiency requirements for as listed below. Motors shall be tested in accordance with IEEE Standard 112, test method B. Motor efficiencies are based upon the NEMA MGI-1987, Table 12-6B (as referenced in the State Energy Code) plus 2.5%.

MINIMUM MOTOR EFFICIENCY TABLE

	Open Motor Premium Efficiency				Closed Motor Premium Efficiency			
Number of Poles	**3600**	**1800**	**1200**	**900**	**3600**	**1800**	**1200**	**900**
Motor Horsepower								
1	-	85.0	79.5	74.5	-	83.0	78.0	74.5
1.5	82.5	85.0	85.0	78.0	81.0	84.0	85.0	78.0
2	85.0	85.0	86.5	88.0	84.0	85.0	85.0	85.0
3	85.0	89.0	88.0	89.0	85.0	86.5	86.5	84.0
5	88.0	89.0	89.0	90.0	88.0	88.0	88.0	86.5
7.5	88.0	91.0	91.0	91.0	90.0	90.0	90.0	90.0

10	90.0	91.0	92.7	92.0	90.0	90.0	90.0	90.0
15	92.0	92.7	92.0	92.0	91.0	92.7	92.0	92.0
20	92.7	93.5	92.7	92.7	91.0	92.7	92.0	92.0
25	93.5	94.2	93.5	92.7	92.0	93.5	92.7	92.0
30	93.5	94.2	94.2	93.5	92.0	93.5	93.5	92.7
40	94.2	94.9	94.2	92.7	92.7	94.2	94.2	92.7
50	94.2	94.9	94.2	94.2	92.7	94.9	94.2	93.5
60	95.5	95.5	94.9	94.9	94.2	95.5	94.2	94.2
75	95.5	96.1	95.5	96.1	94.9	95.5	95.5	95.5
100	95.5	96.1	96.1	96.1	95.5	96.1	95.5	95.5
125	95.5	96.1	96.1	96.1	95.5	96.1	95.5	96.1
150	96.1	96.6	96.1	96.1	95.5	96.6	96.6	96.1
200	96.1	96.6	96.6	96.1	96.6	97.0	96.6	96.6

2.05 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.

2. Split phase.

3. Capacitor start, inductor run.

4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: 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.

PART 3: EXECUTION, GENERAL

3.01 INSTALLATION, GENERAL

A. Install motor and equipment associated with the mechanical installation, including items furnished by others.

B. Provide electrical requirements for equipment installation, connection, and control. Refer to Division 16 for exceptions.

C. Provide power factor correction capacitors on motors as required to correct power factor of the motor to 90 percent or better on all motors 1 horsepower and larger. Turn capacitors over to the Electrical Contractor for installation. The power factors of motors shall be measured at rated loads. Do not provide power factor correction for motors installed with variable frequency drives.

END OF SECTION 23 05 13

SECTION 23 05 19

METERS AND GAGES FOR HVAC PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. Section Includes:

1. Thermometers.
2. Gages.
3. Test plugs.

B. Related Sections:

1. Division 23 Section "Facility Natural-Gas Piping" for gas meters.

1.03 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of product indicated; include performance curves.

C. Shop Drawings: Schedule for thermometers and gages indicating manufacturer's number, scale range, and location for each.

PART 2: PRODUCTS

2.01 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Palmer - Wahl Instruments Inc.
2. Trerice, H. O. Co.
3. Weiss Instruments, Inc.
4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or brass, 7 inches long.

C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.02 DIRECT-MOUNTING, VAPOR-ACTUATED DIAL THERMOMETERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. KOBOLD Instruments, Inc.
3. Marsh Bellofram.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Liquid-filled type, drawn steel or cast aluminum diameter.

C. Element: Bourdon tube or other type of pressure element.

D. Movement: Mechanical, connecting element and pointer.

E. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.

F. Pointer: Red metal.

G. Window: Glass.

H. Ring: Brass is unfinished areas including mechanical rooms. Stainless steel in finished areas.

I. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

J. Thermal System: Liquid- or mercury-filled bulb in copper-plated steel, aluminum, or brass stem for thermowell installation and of length to suit installation.

K. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.03 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.04 PRESSURE GAGES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
2. Marsh Bellofram.

3. Palmer - Wahl Instruments Inc.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Dry type, drawn steel or cast aluminum. Provide 2" diameter for fuel oil systems. 4" diameter for all other systems.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Brass in unfinished areas including mechanical rooms. Stainless steel in finished areas.
9. Accuracy: Grade B, plus or minus 2 percent of middle half.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Remote-Mounting, Dial-Type Pressure Gages: ASME B40.100, indicating-dial type.

1. Case: Dry type, drawn steel or cast aluminum. Provide 2" diameter for fuel oil systems. 4" diameter for all other systems for panel mounting.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red metal.
7. Window: Glass.
8. Ring: Brass in unfinished areas including mechanical rooms. Stainless steel in finished areas.
9. Accuracy: Grade B, plus or minus 2 percent of middle half.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

D. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.05 TEST PLUGS

A. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

B. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.

C. Core Inserts: One or two self-sealing rubber valves.

1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

PART 3: EXECUTION

3.01 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:

1. Inlet and outlet of each hydronic zone.
2. Inlet and outlet of each hydronic boiler and chiller.
3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
4. Inlet and outlet of each hydronic heat exchanger.

B. Install dry, vapor-actuated dial thermometers at suction and discharge of each pump.

C. Provide the following temperature ranges for thermometers:

1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions
2. Condenser Water: 0 to 160 deg F., with 2-degree scale divisions
3. Chilled Water: 0 to 100 deg F, with 2-degree scale divisons
4. Steam and Condensate: 30 to 300 deg F, with 5-degree scale divisions

3.02 GAGE APPLICATIONS

A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.

B. Install dry-case-type pressure gages at chilled and condenser-water inlets and outlets of chillers.

C. Install dry-case-type pressure gages at suction and discharge of each pump.

3.03 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.

C. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.

D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

F. Install remote-mounting pressure gages on panel.

G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids.

H. Install test plugs in tees in piping.

I. Insulate all gauges and thermometer stems fully from the socket trap of the pipe main to the instrument body per the piping insulation type schedules.

3.04 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.

END OF SECTION 23 05 19

SECTION 23 05 23

GENERAL-DUTY VALVES FOR HVAC PIPING

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Iron ball valves.
3. Iron, single-flange butterfly valves.
4. Bronze lift check valves.
5. Bronze swing check valves.
6. Iron swing check valves.
7. Iron swing check valves with closure control.
8. Bronze gate valves.
9. Bronze globe valves.
10. Iron globe valves.
11. Lubricated plug valves.

B. Related Sections:

1. Division 23 HVAC piping Sections for specialty valves applicable to those Sections only.
2. Division 23 Section "Identification for HVAC Piping and Equipment" for valve tags and schedules.

1.04 DEFINITIONS

B. CWP: Cold working pressure.

C. EPDM: Ethylene propylene copolymer rubber.

D. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. RS: Rising stem.

H. SWP: Steam working pressure.

1.05 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.06 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.

2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2: PRODUCTS

2.01 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Gear Actuator: For quarter-turn valves NPS 8 and larger.

2. Handwheel: For valves other than quarter-turn types.

3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 5 plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Gate Valves: With rising stem.

2. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

3. Butterfly Valves: With extended neck.

F. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.

2. Grooved: With grooves according to AWWA C606.

3. Solder Joint: With sockets according to ASME B16.18.

4. Threaded: With threads according to ASME B1.20.1.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.02 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Conbraco Industries, Inc.; Apollo Valves.
b. Crane Co.; Crane Valve Group; Crane Valves.
c. Hammond Valve.
d. Milwaukee Valve Company.
e. NIBCO INC.
f. Tour & Anderson
g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-110.
b. SWP Rating: 150 psig.
c. CWP Rating: 600 psig.
d. Body Design: Two piece.
e. Body Material: Bronze.
f. Ends: Threaded.
g. Seats: PTFE or TFE.
h. Stem: Stainless steel.
i. Ball: Stainless steel, vented.
j. Port: Full.

2.03 BRONZE GROOVED-END CHECK VALVES:

A. Grooved-End Check Valves

1. Manufacturers:

a. Victaulic (Series 716)
b. Milwaukee Valve Company.
c. NIBCO INC.

2. Description:

a. CWP Rating: 300 psi
b. Body Material: ASTM A-536 ductile iron.
c. Ends: Grooved.
d. Spring and Shaft: Stainless steel.
e. Disc: Stainless steel or elastomer coated ductile iron.
f. Suitable for vertical or horizontal installation.

2.04 BRONZE GATE VALVES

A. Class 150, NRS Bronze Gate Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Kitz Corporation.
b. Milwaukee Valve Company.
c. Powell Valves.
d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 1.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: Solid wedge; bronze.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

2.05 BRONZE GLOBE VALVES

A. Class 150, Bronze Globe Valves with Nonmetallic Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Crane Co.
b. Hammond Valve.
c. Milwaukee Valve Company.
d. NIBCO INC.
e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

a. Standard: MSS SP-80, Type 2.
b. CWP Rating: 300 psig.
c. Body Material: ASTM B 62, bronze with integral seat and union-ring bonnet.
d. Ends: Threaded.
e. Stem: Bronze.
f. Disc: PTFE or TFE.
g. Packing: Asbestos free.
h. Handwheel: Malleable iron.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Provide isolation shutoff valves at all supply and return branch hydronic lines routing from the main header piping whether specifically shown on drawings or not. Locate all valves in an accessible location and mark on ceiling tile.

C. Provide Isolation shutoff valves at all supply and return hydronic lines serving each floor, wing, area of the building for shutting down of system and service. Provide valves whether specifically shown on drawings or not. Locate all valves in an accessible location and mark on ceiling tile.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

G. Install chainwheels on operators for ball and butterfly valves NPS 4 and larger and more than 96 inches above floor. Extend chains to 60 inches above finished floor.

H. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Lift Check Valves: With stem upright and plumb.

3.03 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.04 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball or butterfly valves.

2. Butterfly Valve Dead-End Service: Single-flange (lug) type.

3. Throttling Service except Steam: Globe or ball valves.

4. Throttling Service, Steam: Globe valves.

5. 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, metal-seat check valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.

6. For Steel Piping, NPS 5 and Larger: Flanged ends.

3.05 HEATING-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: Two piece, full port, bronze with stainless-steel trim.
3. Bronze Swing Check Valves: Class 150, bronze disc.
4. Bronze Gate Valves: Class 150, NRS.
5. Bronze Globe Valves: Class 150, bronze disc.

END OF SECTION 23 05 23

SECTION 23 05 29

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. This Section includes the following hangers and supports for plumbing system piping and equipment:

1. Steel pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

2. Division 23 Section "Ductwork" for duct hangers and supports.

1.04 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.05 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.06 SUBMITTALS

A. Product Data: For the following:

1. Steel pipe hangers and supports.
2. Fiberglass pipe hangers.
3. Thermal-hanger shield inserts.

4. Powder-actuated fastener systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze pipe hangers. Include Product Data for components.
2. Metal framing systems. Include Product Data for components.
3. Fiberglass strut systems. Include Product Data for components.
4. Pipe stands. Include Product Data for components.
5. Equipment supports.

C. Welding certificates.

1.07 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
2. AWS D1.2, "Structural Welding Code--Aluminum."
3. AWS D1.3, "Structural Welding Code--Sheet Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2: PRODUCTS

2.01 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

D. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.03 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

C. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.04 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.05 INSULATION SHIELD

A. Description: 16 gauge galvanized sheet metal formed to fit contour of pipe insulation.

B. Shield Length: Minimum 12".

2.06 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.07 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.

1. Base: Stainless steel.

2. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

3. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Bases: One or more plastic.

2. Vertical Members: Two or more protective-coated-steel channels.

3. Horizontal Member: Protective-coated-steel channel.

4. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, contin-

uous-thread rods, and rollers for mounting on permanent stationary roof curb.

2.08 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.09 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3: EXECUTION

3.01 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. All piping and ductwork hangers, saddles and all associated rods, clips, bolts, supports, shields, straps and building attachments shall be stainless steel where located in wash bay, wash bay equipment or chemical storage rooms.

G. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.

2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.

3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.

4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.

9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.

10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.

11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.

12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.

13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.

14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.

15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.

H. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.

2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

3. Insulate all Vertical piping clamps connections.

I. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.

2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.

4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.

5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.

3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.

4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.

5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.

6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.

8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.

9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.

10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.

11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.

14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.

15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.

2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.02 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and

attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.

D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.

F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

G. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

H. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.

I. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

K. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

L. Install lateral bracing with pipe hangers and supports to prevent swaying.

M. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

N. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

O. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

P. Insulated Piping: Comply with the following:

1. Attach clamps and spacers to piping.

   a. Piping Operating above or below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.

   b. Do not exceed pipe stress limits according to ASME B31.1 for power piping and ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

   a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

   a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
   b. NPS 4: 12 inches long and 0.06 inch thick.
   c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Insert Material: Length at least as long as protective shield.

6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.04 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for [trapeze pipe hangers] [and] [equipment supports].

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.

2. Obtain fusion without undercut or overlap.

3. Remove welding flux immediately.

4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.05 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.06 PAINTING

A. Touch Up: 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.

B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 23 05 29

SECTION 23 05 53

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Valve tags.
6. Warning tags.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of product indicated.

C. Samples: For color, letter style, and graphic representation required for each identification material and device.

D. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

E. Valve numbering scheme.

F. Valve Schedules: For each piping system to include in maintenance manuals.

1.05 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2: PRODUCTS

2.01 EQUIPMENT LABELS

A. Metal Labels for Equipment:

1. Material and Thickness: Brass, 0.032-inch or Stainless steel minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

4. Fasteners: Stainless-steel rivets or self-tapping screws.

5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

2. Letter Color: White.

3. Background Color: Black.

4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

7. Fasteners: Stainless-steel rivets or self-tapping screws.

8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.02 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.03 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.

2. Lettering Size: At least 1-1/2 inches high.

3. Color: Provide background and lettering color in accordance with Part 3 applications.

2.04 DUCT LABELS

A. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

B. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

C. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

D. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

E. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction to cover full circumference or perimeter of ductwork.

2. Lettering Size: At least 1-1/2 inches high.

3. Color: Provide background and lettering color in accordance with Part 3 applications.

2.05 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass or Stainless steel minimum thickness, and having predrilled or stamped holes for attachment hardware.

2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-tag schedule shall be included in operation and maintenance data.

2.06 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3: EXECUTION

3.01 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.02 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

C. Provide equipment labels for each piece of equipment identified on drawing schedules.

3.03 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.

2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. At each side of penetrations through all walls, floors, ceilings, and inaccessible enclosures.

4. At access doors, manholes, and similar access points that permit view of concealed piping.

5. Near major equipment items and other points of origination and termination.

6. Spaced at maximum intervals of 30 feet along each run. Reduce intervals to 15 feet in areas of congested piping and equipment.

7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

8. Where major devices, valves, dampers, etc are above ceiling, provide equipment identification on ceiling grid to assist in locating device. Include direction arrow to identify specific tile.

B. Pipe Label Color Schedule:

1. Heating Water Piping:

a. Background Color: Red.
b. Letter Color: White.

2. Refrigerant Piping:

a. Background Color: Black.
b. Letter Color: White.

3. Natural Gas Piping:

a. Background Color: Yellow.
b. Letter Color: Black.

3.04 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:

1. Supply, Return, and Mixed air:
a. Background Color: Green
b. Letter Color: White

2. Exhaust and Relief Air:
a. Background Color: Red
b. Letter Color: White

3. Outside Air:
a. Background Color: Blue
b. Letter Color: White

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 20 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tag Size and Shape:

a. Refrigerant: 1-1/2 inches, round.
b. Hot Water: 1-1/2 inches, round.
c. Gas: 1-1/2 inches, round.

2. Valve-Tag Color:

a. Refrigerant: Natural.
b. Hot Water: Natural.
c. Gas: Natural.

3. Letter Color:

a. Refrigerant: Black.
b. Hot Water: Black.
c. Gas: Black.

3.06 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 23 05 53

SECTION 23 05 93

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1: GENERAL

1.01 QUALIFICATIONS

A. The Balancing Contractor shall be a certified member of the Associated Air Balance Council or the National Environmental Balancing Bureau and shall issue, upon receipt of contract, an A.A.B.C. “National Project Certification Performance Guarantee”.

B. The Balancing Contractor shall have a minimum of five (5) years corporate existence along with balancing personnel assigned to this project that each have a minimum of five (5) years experience of successful balancing Mechanical Building Systems in facilities similar to this project.

1.02 SCOPE

A. The mechanical system balancing shall include all labor, materials, skills, instruments and equipment necessary to perform a complete and proper heating, ventilating and air conditioning system balance adjustment as intended by the Contract Documents, including the following:

1. Complete ventilating, air conditioning and exhaust systems, balancing the airflow to and from all openings, adjusting dampers, fan speeds and making adjustments necessary to provide fully balanced systems performing as intended by the Contract Documents.

    a. The setting and adjusting of all dampers, deflecting vanes, discharge vanes, and accessories to achieve proper air distribution and patterns in all parts of the air supply, return, relief and exhaust systems.

    b. Adjusting of all belt-drive fan speeds to attain design or optimum total CFM deliveries.

    c. The balancing contractor shall be responsible for providing and installation to replace and install all fan and motor sheaves and belts as required to achieve the required airflow and static from each piece of equipment (new and existing). The TAB contractor shall be responsible for testing and preliminarily balancing of the equipment and system after changes have been made prior to final testing and balancing.

2. Piped/pumped systems of all hydronic water, condenser water, and other systems, balancing the flow to/from each device and making such test and adjustments necessary to meet the required volume and performance intended by the Contract Documents.

3. Domestic Piped/pumped systems of all domestic hot water recirculating systems, balancing the flow to/from each circulation balancing valve and circ pump making such test and adjustments necessary to meet the required volume and performance intended by the Contract Documents.

4. The testing and balancing contractor shall perform a complete balancing of the entire existing and new building ventilation, air conditioning, exhaust, and hydronic systems to meet the new design requirements as well as the existing conditions to remain. Original documents referencing the existing building ventilation and hydronic equipment to be rebalanced shall be provided by the owner to the contractor for information on the balancing of the existing equipment.

5. The testing and balancing contractor shall be familiar with phasing of construction and shall responsible for providing preliminary testing and balancing of the system after each phase in completed and shall provide a final complete test and balance after all phases are complete.

6. The testing and balancing contractor shall provide a pre-balance prior ceiling being installed in areas where access is limited due to inaccessible ceiling.

7. The TAB contractor shall coordinate with the mechanical contractor to verify exact locations of balancing valves, dampers, etc. prior to completion to allow for work to be performed.

B. The Mechanical Contractor shall provide the balancing agency with a copy of the project specifications, the latest approved mechanical drawings, fan submittals, pump curves, coil data, control diagrams and any other necessary information required to perform the balancing and adjusting with information listing all changes, revisions, additions, etc. that pertain to the balancing and adjusting of the mechanical systems.

C. The Mechanical Contractor shall instruct his employees and subcontractors to leave all devices in a wide-open position and to free all operating arms and adjustments so they can be easily operated.

D. The Mechanical Contractor shall be certain that all systems are in proper operation; and prior to the balancing and adjusting, will install clean filters in all air systems, clean all water strainers and maintain same during the balancing and adjusting operations.

E. The Balancing Contractor shall enlist the aid of the installing contractor, subcontractors or equipment suppliers and whenever such aid is required, it shall be provided at no additional cost to the Balancing Contractor or to the Owner.

F. All balancing procedures and instrumentation shall be in accordance with the requirements and recommendations of A.A.B.C. “National Standards for Field Measurements and Instrumentation Total System Balance”.

G. Instruments used for balancing systems must have been calibrated within a period of six (6) months prior to balancing this project.

H. The Balancing Contractor shall cooperate with the Engineer and the Contractor installing the work to effect a smooth coordination of the balancing work with the job schedule.

1.03 REFERENCES

A. National Environmental Balancing Bureau (NEBB) “Procedural Standards”.

B. Associated Air Balance Council (AABC) Manual MN-1.

C. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) Handbook “HVAC Systems and Applications”.

D. Sheet Metal Contractors National Association (SMACNA) Publications.

1.04 SUBMITTALS

A. The Balancing Contractor shall submit three (3) certified copies of the balancing reports to the Architect/Engineer for evaluation of the system operation. The balancing report shall adhere to the A.A.B.C. general outlines, however, modifications shall be made, adding or deleting specific items as may be required to suit individual system needs.

B. The balancing work shall include a report and review of the required work with the Engineer before beginning field balance work. Provide two (2) inspections of the system during construction. Submit a report of the findings in writing to the Engineer.

C. All reports shall be signed by a supervisor who is certified by the National Environmental Balancing Bureau (NEBB) or the Associated Air Balance Council (AABC).

D. Balancing reports shall include identification and types of balancing instruments used and date of most recent calibration.

PART 2: PRODUCTS AND EXECUTION

2.01 BALANCING AIR SYSTEMS

A. Air quantity in all main ducts shall be measured by pilot tube traverse. Where necessary for proper balancing, similar measurements shall be made in branch ducts. Openings in ducts for pilot tube insertion shall be sealed with plugs. Outlet and inlet air quantities shall be determined by anemometer in accordance with outlet and inlet manufacturer's recommendation.

B. Dampers shall be permanently marked after air balance is complete so that they can be restored to their correct position if disturbed at any time.

C. Adjusting of individual outlets shall be performed under procedures recommended by the manufacturers of the outlets or as otherwise approved by the Engineer.

D. These adjustments shall be made with all fans in operation, the filters in place, and all room doors and other openings in the normal operating position.

E. The total airflow CFM of all outlets, as recorded in the balance report and within acceptable limits, shall agree with the measured airflow CFM at the fan or in the main and/or branch ducts.

F. Patch holes in insulation, ductwork and housing, which have been cut or drilled for test purposes, in manner recommended by original installer.

G. Mark equipment settings, including damper control positions, fan speed control levers, and similar controls and devices, to show final settings at completion of balancing work. Provide markings with paint or other suitable permanent identification materials.

H. Balance the air deliveries from each unit in accordance with recommendations of the diffuser, register, or grille manufacturer; setting fan speeds, dampers, controls and/or other volume control devices in such a manner as to produce the air volumes shown on the drawings. Record the following items:

1. Room number or name.
2. Grille, register or diffuser type and size.
3. Specified CFM.
4. Actual CFM
5. Volume of air handled by each supply, return and exhaust fan.
6. Static pressure at inlet and outlet of each fan, coil, and filter.
7. Speed of all fans and motors.
8. Rated fans and motors.
9. Actual fan motor amperage.
10. Outside air and exhaust air quantities for fans and air handing units.

I. Balance vehicle areas to have a slight negative pressure relationship to offices areas, but slight positive pressure to outdoors.

2.02 BALANCING HYDRONIC SYSTEMS

A. The Balancing Contractor shall prepare the hydronic system for balancing in the following manner:

1. Open all valves to full open position. Close coil bypass stop valves. Set mixing valve to full coil flow.
2. Installing Contractor to remove and clean all strainers.
3. Examine water in system and determine if water has been treated and cleaned.
4. Check pump rotation.
5. Check expansion tanks to determine they are not air bound and the system is completely full of water.
6. Check all air vents at high points of water systems and determine all are installed and operating freely.
7. Set all temperature controls so all coils are calling for full cooling. This should close all automatic bypass valves at coil and chiller. Follow same procedure when balancing hot water coils, set on full call for heating.
8. Check operation of automatic bypass valve.
9. Check and set operating temperatures of boilers and chillers to design requirements.
10. Balancing of air systems shall be complete before actual balancing of hydronic systems begins.
11. The Balancing Contractor shall then proceed with balancing of the hydronic systems.

B. For each pump measure and record the following data:

1. Specified GPM, pressure difference, RPM, horsepower, electrical characteristics.
2. Actual pressure difference.
3. Actual RPM.
4. Motor nameplate amps, volts and horsepower.
5. Actual measured motor volts and amps.

C. Plot the actual system pump curve using actual measured values of GPM, pressure difference and RPM.

D. When a standby pump backs up more than one system, separate readings shall be taken for each standby pump operation for each system.

E. Flowmeter Station: When flow measuring devices are used, record GPM at each.

F. Hydronic Coil: Record GPM at each.

G. Each pump and flow measuring device shall be identified. Flow-measuring device may be identified by referencing the coil or coil bank it controls.

2.03 CONTROL SYSTEMS

A. The control systems shall be tested under operating conditions with the actual operations verified and temperature readings taken around each control point to verify the correct control function or operation. All damper functions

shall be similarly verified. These results shall also be recorded onto certificates and submitted to the Architect/Engineer.

B. The Balancing Contractor shall at all times during the balancing and adjusting operations note any deficiencies, malfunctions or omissions that are discovered. These problems shall be reported to the proper parties for correction and to the Engineer.

C. The Control Systems Contractor shall be responsible for the proper setting of the motors to stroke dampers, valves, etc., as set by the Balancing Contractor.

2.04 PREPARATION

A. Review the contract documents and shop drawings and identify to the Mechanical Systems Installers where balancing devices are required and not indicated.

B. Examine installed work and conditions under which testing and balancing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with balancing work until unsatisfactory conditions have been corrected in manner acceptable to the Balancer.

2.05 REPORTS

A. Prepare a report of test results, including instrumentation calibration reports, in format recommended by applicable standards. Include in the report all information obtained in balancing on the mechanical systems as specified herein.

B. Prepare a report of recommendations for correcting unsatisfactory mechanical performances when a system cannot be successfully balanced, including, where necessary, modifications which exceed requirements of the contact documents for mechanical work.

2.06 RETEST SYSTEM

A. Retest, adjust and rebalance systems subsequent to significant system modifications, and resubmit test results.

END OF SECTION 23 05 93

SECTION 23 07 00

HVAC INSULATION

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. Section Includes:

1. Insulation Materials:

    a. Flexible elastomeric.
    b. Mineral fiber.
    c. Polyolefin.

2. Insulating cements.
3. Adhesives.
4. Mastics.
5. Lagging adhesives.
6. Sealants.
7. Factory-applied jackets.
8. Field-applied fabric-reinforcing mesh.
9. Field-applied cloths.
10. Field-applied jackets.
11. Tapes.
12. Securements.
13. Corner angles.

B. Related Sections:

1. Division 21 Section "Fire-Suppression Systems Insulation."
2. Division 22 Section "Plumbing Insulation."
3. Division 23 Section "Ductwork" for duct liners.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

C. Shop Drawings:

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.

2. Detail attachment and covering of heat tracing inside insulation.

3. Detail insulation application at pipe expansion joints for each type of insulation.

4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.

5. Detail removable insulation at piping specialties, equipment connections, and access panels.

6. Detail application of field-applied jackets.

7. Detail application at linkages of control devices.

8. Detail field application for each equipment type.

D. Qualification Data: For qualified Installer.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Work shall be done per “Commercial and Industrial Insulation Standards;” published by the Midwest Insulation Contractors Association, by firms with at least five (5) years corporate experience.

C. Material shall be delivered to job site in original unbroken factory sealed packaging, labeled with manufacturer’s density and thickness, and fire and smoke ratings. Materials shall be protected from weather and kept clean and dry

D. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.07 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2: PRODUCTS

2.01 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Flexible Elastomeric (FE): Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials; thermal conductivity (avg) of 0.27 Btu/hr-ft^2-°F or lower at mean temperature of 75°F; 3.0 lbs./ft^3 density (ASTM D/622); 0.08 perm-in permeability (ASTM E96); 0.2% water absorption (ASTM C209). Provide field applied jacket on all exposed indoor and exterior piping.

G. Mineral-Fiber Blanket Insulation (MF): Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I; thermal conductivity (avg) of 0.27 Btu/hr-ft^2-°F or lower at mean temperature of 75°F. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. Refer to Part 3 below for insulation density.

H. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type 1, 3.0 lb./cu. ft. density for up to 450°F. Service shall meet or exceed ASTM C 680 thermal conductivity test of .23 BTU-in/hr-ft^2 - °F at 75°F mean temperature. Provide with factory applied FSK jacket.

I. Rigid Fiberglass Ductwork Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C612, Type 1, 3.0 lb./cu. ft. density for up to 450°F. Service shall meet or exceed ASTM C 680 thermal conductivity test of .23 BTU-in/hr-ft^2 - °F at 75°F mean temperature. Provide with factory applied FSK jacket.

J. Mineral-Fiber, Preformed Pipe Insulation (MF): Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL; thermal conductivity (avg) of 0.25 Btu/hr-ft^2-°F or lower at mean temperature of 75°F. Factory-applied jacket requirements are specified in “Factory-Applied Jackets” Article.

K. Mineral-Fiber, Pipe and Tank Insulation (MF): Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 3.5 lb/cu. ft.or more. Thermal conductivity (k-value) at 100 deg Fis 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

L. Polyolefin (P): Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials; thermal conductivity (avg) of 0.25 Btu/hr-ft^2-0F or lower at mean temperature of 75°F; 1.5 lbs./ft^3 density (ASTM D1622); 0.0 perm-in permeability (ASTM E96); 0.0% water absorption (ASTM C209).

2.02 INSULATING CEMENTS

A. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

2.03 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

2.04 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

2. Service Temperature Range: Minus 20 to plus 180 deg F.

3. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

4. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

2. Service Temperature Range: Minus 20 to plus 200 deg F.

3. Solids Content: 63 percent by volume and 73 percent by weight.

4. Color: White.

2.05 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.

2. Service Temperature Range: Minus 50 to plus 180 deg F.

3. Color: White.

2.06 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.

4. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Materials shall be compatible with insulation materials, jackets, and substrates.

2. Fire- and water-resistant, flexible, elastomeric sealant.

3. Service Temperature Range: Minus 40 to plus 250 deg F.

4. Color: White.

2.07 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I, for applications where the systems operate below ambient temperature at least part of the time or where a vapor barrier is required.

2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I, for applications where the systems operate below ambient temperature at least part of the time or where a vapor barrier is required.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II. Vapor retarder shall be rated for 150°F service, ASTM E 96 vapor permeance rated at 0.02 perms., for applications where systems operate above ambient temperatures or where a vapor retarder is not required.

2.08 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, as follows:

1. Shall comply with ASTM C921, Type I, for applications where the systems operate below ambient temperature at least part of the time or where a vapor barrier is required.

2. Shall comply with ASTM C921, Type II, for applications where systems operate above ambient temperatures or where a vapor retarder is not required.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Adhesive: As recommended by jacket material manufacturer.

2. Color: White.

3. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

4. Factory-fabricated tank heads and tank side panels.

5. Provide paintable PVC jacket on all exposed piping not concealed with a ceiling or chase.

C. Fitting Covers:

1. PVC Jacket: One or two piece pre-molded high impact PVC fitting covers with fiberglass inserts and accessories. Covers shall be UV resistant and comply with ASTM 1784-92. Covers shall be sized to comply with insulation applications detailed in Part 3.0.

a. Below ambient systems: provide continuous vapor barrier in accordance with manufacturer recommendations.

b. Fiberglass Inserts: Thermal conductivity (ASTM C177), thermal conductivity average of 0.26 Btu/hr-ft^2-˚F or lower at a mean temperature of 75 ˚F.

D. Metal Jacket:

1. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

a. Factory cut and rolled to size.
b. Finish and thickness are indicated in field-applied jacket schedules.
c. Moisture Barrier for Outdoor Applications: 2.5-mil- thick Polysurlyn.
d. Factory-Fabricated Fitting Covers:

1) Same material, finish, and thickness as jacket.
2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
3) Tee covers.
4) Flange and union covers.
5) End caps.
6) Beveled collars.
7) Valve covers.
8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2.09 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Width: 3 inches.

2. Thickness: 11.5 mils.

3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.

6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Width: 3 inches.

2. Thickness: 6.5 mils.

3. Adhesion: 90 ounces force/inch in width.

4. Elongation: 2 percent.

5. Tensile Strength: 40 lbf/inch in width.

6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: Paintable white vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Width: 2 inches.

2. Thickness: 6 mils.

3. Adhesion: 64 ounces force/inch in width.

4. Elongation: 500 percent.

5. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.

2. Thickness: 3.7 mils.

3. Adhesion: 100 ounces force/inch in width.

4. Elongation: 5 percent.

5. Tensile Strength: 34 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304; 0.015 inch wide with wing seal.

2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch wide with wing seal.

B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

a. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

b. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

c. Adhesive-backed base with a peel-off protective cover.

5. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

6. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.

2.11 CORNER ANGLES

A. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 PIPING INSULATION APPLICATION

A. Indoor Piping System Insulation: Insulate with insulation types and thicknesses as listed in the table below. If more than one pipe material is listed for a piping system, selection from materials listed is the contractor's option.

TABLE NO. 23 07 00: MINIMUM PIPE INSULATION

			Insulation Thickness in Inches for Pipe Sizes				
Piping System Types	**Fluid Temp Range, °F**	**Type of [1] Insulation**	**3/4" and Smaller**	**1" to 1 ¼"**	**1 ½" to 3"**	**4" to 6"**	**8" and Larger**
Conditioned Spaces							
Hot Water (7)	105-200	MF	1½"	1½"	2"	2"	2"
Condensate Drains	Any	FE, P	½"	1"	1"	-	-
Refrigerant (Suction)	40-55	FE, P	½"	½"	1"	1"	-
Refrigerant (Hot Gas)[4]	Up to 140	MF	1"	1"	1½"	-	-
Unconditioned Spaces[6]							
Refrigerant (Suction)	40-55	FE, P	1"	1"	1½"	1½"	-

[1] Insulation material abbreviations:
  a. Mineral fiber (MF) – with factory applied jacket per part 2.0 requirements.
  b. Flexible Elastomeric (FE)
  c. Polyolefin (P)

[2] Provide flexible elastomeric cellular insulation at valves and fittings with paintable PVC jacket on all exposed paintable. Refer to drawings for installation details.

[3] Provide two layers of insulation for thickness 1 ½" and greater. Longitudinal seams shall be offset to ensure a continuous vapor barrier.

[4] Insulation not required outside of the building.

[5] Insulate piping indicated within 10 feet at the exterior envelope.

[6] Unconditioned spaces shall include all systems indicated located in mechanical rooms, tunnels, boiler rooms, out door storage rooms, and outside the building envelope.

[7] For hot water, steam and steam condensate piping only, piping smaller than 1½" and located in partitions within conditioned spaces, reduction of these thicknesses by 1" shall be permitted, but not to thicknesses below 1".

B. Refer to Division 23 Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment" for insulation insert and insulation shield requirements.

C. Outdoor Piping System Insulation: Increase insulation thicknesses indicated for indoor applications by ½". All outdoor insulation shall be flexible elastomeric or polyolefin. Provide with weather barrier aluminum jacket.

D. Insulation Omitted: Omit insulation for the following:

1. Hot low pressure piping within radiation enclosures or unit cabinets.
2. Cold piping within unit cabinets provided piping is located over drain pan.

3.04 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Indoor, concealed supply, outdoor, and combustion air.
2. Indoor, exposed supply (unless otherwise noted), outdoor air, and combustion air.
3. Indoor, concealed return and exhaust located in nonconditioned space. This includes ducted returns above a non-plenum ceiling. Return ducts in a return air plenum do not require insulation.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed exhaust and relief between isolation damper and penetration of building exterior.

6. Indoor, exposed exhaust and relief between isolation damper and penetration of building exterior.
7. Outdoor, concealed supply, return, outdoor air and exhaust.
8. Outdoor, exposed supply, return, outdoor air and exhaust.

B. Items Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.

3.05 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Concealed, supply-air duct and plenum insulation:

1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.0-lb/cu. ft nominal density.

B. Concealed, return-air duct and plenum insulation; non-conditioned areas including ducted returns in a non-plenum ceiling (insulation not required in return air ceiling plenums or in chases or shafts within the conditioned building perimeter):

1. Mineral-Fiber Blanket: 1-½ inches thick and 1.0-lb/cu. ft nominal density.

C. Concealed, outdoor and combustion air duct and plenum insulation:

1. Mineral-Fiber Blanket: 2 inches thick and 1.0-lb/cu. ft nominal density.

D. Concealed, exhaust-air and relief-air duct and plenum insulation (within 10 feet of exterior wall or roof):

1. Mineral-Fiber Blanket: 1-½ inches thick and 1.0-lb/cu. ft nominal density.

E. Exposed, supply-air duct and plenum insulation (insulation not required on exposed ductwork within a conditioned space):

1. Mineral-Fiber Board: 2 inches thick and 3.0-lb/cu. ft nominal density.

F. Exposed, supply, return-air duct and plenum insulation, non-conditioned areas:

1. Mineral-Fiber Board: 2 inches thick and 3.0-lb/cu. ft nominal density.

G. Exposed, outdoor and combustion air duct and plenum insulation:

1. Mineral-Fiberboard: 2 inches thick and 3.0-lb/cu.ft. nominal density.
2. Mineral-Fiberblanket: 2 inches thick and 1.5 lb/cu.ft nominal density. For round ducts only.

H. Exposed, exhaust-air and relief-air duct and plenum insulation:

1. Mineral-Fiber Board: 2 inches thick and 3.0-lb/cu. ft nominal density.

I. Flexible Elastomeric Duct Liner: (Preformed, cellular, closed-cell):

1. Closed cell foam, 0.25 BTU/in/Sq.ft. at 75degF
   a. Provide at all transfer ducts shown on the drawings.
   b. Provide at all supply and return ductwork a minimum distance of 15 feet from the air handling, rooftop units, vertical unit ventilators, fan coil units, heat pumps, etc.

c. All ductwork installed with sound insulating closed cell liner as specified shall also be externally wrapped with duct insulation per the insulation schedules.

3.06 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

C. Heating-hot-water expansion/compression tank insulation shall be:

1. Flexible Elastomeric: 1 inch thick.

D. Heating-hot-water air-separator insulation shall be:

1. Flexible Elastomeric: 1 inch thick.

3.07 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and all piping including fittings, drains, valves, control valve bodies, expansion joints and specialties. All piping including piping, fitting and specialties between valves and coil shall be insulated.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. For all insulation, seal. Exposed fiberglass including cut pre-formed pipe sections with manufacturer's approved mastic.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.

2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

N. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

O. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

P. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

Q. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.08 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.

4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.

2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 Section "Firestopping" for firestopping and fire-resistive joint sealers.

E. Insulation Installation at Floor Penetrations:

1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Firestopping."

3.09 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.

3. Protect exposed corners with secured corner angles.

4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

a. Do not weld anchor pins to ASME-labeled pressure vessels.

b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.

c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches o.c. in both directions.

d. Do not over-compress insulation during installation.

e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.

f. Impale insulation over anchor pins and attach speed washers.

g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.

6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two circumferential girdles 12 inches o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches o.c. Use this network for securing insulation with tie wire or bands.

7. Stagger joints between insulation layers at least 3 inches.

8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.

9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.

10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.

B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.

1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.

3.10 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Fiberglass inserts with PVC fitting covers are acceptable. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.

a. Fiberglass inserts with a thickness and density equal to the adjacent pipe insulation with a pre-formed PVC fitting cover may be used in lieu of preformed or mitered fitting covers.

3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Fiberglass inserts with PVC fitting covers are acceptable. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Fiberglass inserts with PVC fitting covers are acceptable. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.

5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Fiberglass inserts with PVC fitting covers are acceptable. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.

7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.

9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.

3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.

4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend

insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

E. Provide paintable PVC jacket on all exposed piping not with ceiling or chase spaces. All exterior piping shall be jacket with an aluminum jacket.

F. Provide 16 gauge galvanized sheet metal insulation shields at all hanger locations. Shields shall be a minimum of 12” in length and formed to fit pipe contour.

3.11 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.

2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.12 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.

3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.

4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.

4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.

2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not overcompress insulation during installation.

e. Impale insulation over pins and attach speed washers.

f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.

c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.

d. Do not over-compress insulation during installation.

e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.

    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch- wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.13 POLYOLEFIN INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.

2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.

2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.

2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

3. Install insulation to flanges as specified for flange insulation application.

4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.14 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.

2. Install lap or joint strips with same material as jacket.

3. Secure jacket to insulation with manufacturer's recommended adhesive.

4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.

5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Provide paintable PVC jacket on all exposed piping not with ceiling or chase spaces. All exterior piping shall be jacket with an aluminum jacket.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.15 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Outdoor Ducts and Plenums:

1. Aluminum, Smooth of the same gauge as the enclosed duct.

D. Outdoor Piping:

1. Aluminum, Smooth with Z-Shaped Locking Seam, 0.032 inch thick.

END OF SECTION 23 07 00

SECTION 23 09 00

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 SCOPE

A. This Section includes all labor, materials, equipment, skills, tools, wiring, hardware and software necessary to provide control of building HVAC systems as specified herein, and as required for fully functioning building HVAC control systems.

B. Building HVAC control systems as specified herein shall be of the 24-volt programmable electronic type, with stand-alone equipment controls.

C. Provide the following electrical work as work of this Section, comply with requirements of Electrical Division Sections:

1. Power supply wiring from power source to power connections on controls and/or modules. Provide all 24 VAC transformers as required for all control operations. Coordinate with the Electrical Contractor for the locations and quantities of available spare breakers.
2. Provide line or low voltage (as applicable) control wiring between field-installed controls, indicating devices, thermostats and unit control panels.
3. Provide raceways and electrical boxes and fittings complying with Electrical Division Sections “Basic Materials and Methods”, “Raceways” and “Electrical Boxes and Fittings”.
4. Conduit and junction boxes for all control devices (temperature sensor, thermostats, wall switches, etc.) shall be provided by this Contractor. Route conduit from control device junction boxes in wall up to ceiling spaces. All wiring in Mechanical rooms and Electrical rooms shall be completely in conduit.
5. This Contractor shall provide relays as required for starters of all 120/1-volt equipment not furnished with factory starters, or if starters are not furnished by the Electrical Contractor. Control relays shall be provided in NEMA 1 enclosures.
6. All conduits in spaces other than mechanical rooms and electrical rooms that are not routed above the ceiling shall be concealed in the walls. It is the responsibility of this Contractor to coordinate conduit required to be installed in poured concrete walls prior to construction.

D. Refer to other Division 23 sections for installation of instrument wells and dampers in mechanical systems; not work of this Section.

E. Refer to Electrical Division sections for the following work; not work of this Section.

1. Power supply wiring from power source to power connections on electrically operated equipment. This work includes wiring of starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.2 REFERENCES

A. UL Compliance: Provide electrical products and components, which have been tested, listed and labeled by Underwriters laboratories (UL).

B. NEMA Compliance: Comply with NEMA Standards pertaining to components and devices for electric-electronic HVAC control systems.

C. NFPA Compliance: Comply with the requirements of National Fire Protection Association (NFPA) Standards 70 and 90A.

D. ANSI Compliance: Comply with American National Standards Institute (ANSI) Standards pertaining to components and devices for electric-electronic HVAC control systems.

1.3 ELECTRICAL WORK

A. Provide the following electrical work as work of this section, complying with all Division 26 specification requirements:

1. Power supply wiring from power source to power connections on controls and/or control modules. Provide all 24 VAC transformers as required for all control operations. Coordinate with the electrical contractor for the locations and quantities of available spare breakers. Review the Electrical Drawings prior to bid to determine power source locations and voltage. The Building Automation System Contractor is required to provide all transformer installations as required for the available power voltage.
2. Control wiring between field-installed controls, indicating devices, thermostats and sensors unit control panels.
3. Raceways, and Electrical Boxes and Fittings: Provide raceways, and electrical boxes and fittings complying with Division 26 specifications.
4. Conduit and junction boxes for all control devices (temperature sensor, thermostats, wall switches, etc.) shall be provided by the Building Automation System Contractor. Route conduit from control device junction boxes in wall up to ceiling/plenum spaces. All wiring in outdoors and in mechanical rooms, electrical rooms and similar spaces shall be completely in conduit.
5. The Temperature Control Contractor shall provide relays as required for starters of all 120/1-volt equipment not furnished with factory starters, or if starters are not furnished by the Electrical Contractor. Control relays shall be provided in NEMA 1 enclosure.
6. All conduit in spaces other than mechanical rooms, boiler rooms, and electrical rooms that is not routed above the ceiling shall be concealed in walls. It is the responsibility of the Building Automation System Contractor to coordinate conduit required to be installed in poured concrete walls prior to construction.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Provide automatic control system equipment and components manufactured by a firm with a minimum ten (10) years corporate existence in the manufacture of automatic controls systems for commercial applications.

B. Installer Qualifications: Provide a skilled HVAC Control System Installer with a minimum of five (5) years experience of successfully installing automatic control systems in facilities similar to this project, and who is an authorized representative and certified installer of the Control System Manufacturer for both installation and maintenance of units required for this project. The installer must have a minimum of four (4) successfully completed projects with similar control systems design, size and installation to that specified herein within a 100-mile radius of the project site. The installer must have a branch office with factory trained service personnel within a 100-mile radius of the project site and be capable of providing emergency assistance within a four (4) hour period.

C. Subcontractor Qualifications: A “subcontractor” shall be defined as a company, other than the successful awarded bidder, who is contracted for the purposes of installation, or other labor, to complete the work as described in the bidding documents for the successful awarded bidder. All subcontractors shall be prior approved in same manner as required for substitute material and manufacturers or products not specifically listed as approved in these specifications in accordance with the requirements of the Specifications. A subcontractor must meet the above noted requirements to be approved as part of the prior approval process. The successful awarded bidder may not contract with a subcontractor that installs and/or services building control systems products, equipment and instrumentation of more than one (1) control system manufacturer. The intent of this specification is to maintain high quality standards.

1.5 SUBMITTALS

A. Product Data: Include complete manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control.
2. Each product marked with tag or label used in Shop Drawings.
    a) Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Schematic flow diagrams showing fans, coils, dampers, sensors and control devices.
4. Wiring Diagrams: Power, signal, and control wiring, Differentiate between manufacturer-installed and field-installed wiring. Coordinate with controlled equipment wiring diagrams. Include sample of control wiring.
5. Details of control panel faces, including controls, instruments, and labeling.
6. Written description of sequence of operation with equipment identified with same label as indicated on the drawings.
7. Schedule of dampers including size, leakage, and flow characteristics.
8. Trunk cable schematic showing programmable control unit locations and trunk data conductors.
9. Listing of connected data points, including connected control unit and input device.
10. System configuration showing peripheral devices, batteries, power supplies, diagrams, and interconnections.

B. Maintenance Data: Include the following information in the submittals. Insert a copy in the Owner's operation and maintenance (O&M) manuals:

1. Maintenance instructions and lists of spare parts for each type of control device
2. Interconnection wiring diagrams with identified and numbered system components and devices.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Key panel illustrations and step-by-step procedures indexed for each operator function.
5. Calibration records and list of set points.

C. Project Record Documents: Record actual locations of control components, including control units, thermostats, and sensors. Revise Shop Drawings to reflect actual installation and operating sequences.

D. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

E. Acceptance Statement: Signed by Owner and Engineer stating that training has been completed, and operation and maintenance information has been received.

1.6 APPROVED MANUFACTURERS

A. Subject to compliance with specified requirements, manufacturers and associated system installers offering Building HVAC Control Systems which may be provided on this project include the following:

1. Alerton – Installed by Northern Air Corporation, St. Paul, MN 651-255-3520
2. Honeywell WEBS– Installed by Hayes Automation – Woodbury, MN, 651-299-0888
3. Schneider Electric StruxureWare– Installed by UHL Company, Minneapolis, MN, 763-425-7226

PART 2 PRODUCTS

2.1 CONTROL EQUIPMENT

A. HVAC Equipment Programmable Controllers and Central Control Panels (Basis of Design)

1. Install for control of building HVAC equipment shall be central programmable controller(s) and central control panel(s). Controller shall be a Honeywell JACE programmable controller with a control panel, or prior approved equal. The Honeywell Controller and control panel shall be furnished and installed and wired under this Section of these Specifications. The Honeywell controller shall be UL listed and contained in a NEMA-1 enclosure.
2. The Honeywell JACE controller shall have a liquid crystal display (LCD) operator touch screen for monitoring and changing building control functions, set points and scheduled occupancy times, and shall allow for system diagnostics, trouble alarms, with included manual override outputs.
3. The Honeywell controller shall be compatible and interface with the remote mounted HVAC equipment control panels.
4. The Honeywell controller shall have universal inputs, static pressure inputs, binary outputs, and analog outputs as required for control of the associated HVAC system as described in the sequences of operation portion of this specification.
5. The Honeywell controller shall allow for a minimum of two (2) on/off times per day and 20 exception schedules per year. Controller shall include an integral line-to-voltage transformer, 365-day time clock, super capacitor (battery) seven (7) day back-up, and communicate by means of BacNet protocol.
6. The Honeywell Controller shall be capable of interfacing with a PC workstation and allow for system networking for monitoring, alarm indication and setpoint adjustment.
7. The Honeywell space thermostats will control the normal operation of the equipment per the mode set on the space thermostat. The control of the equipment will be controlled via the units integral control.
8. The Honeywell JACE controller will control the time of day schedule for all of the equipment.
9. Each individual piece of equipment will broadcast back to the Honeywell JACE controller its the space temp, DAT, RAT, and OAT temp.
10. Provide trending for DAT, RAT, OAT and Space temperature through Honeywell JACE controller. Trending to be based on graphical charts that can be accessed and viewed by end user.
11. The Honeywell JACE controller will have a graphic floor plan layout detailing all space sensor locations and unit locations. There will be a separate graphic page for each piece of equipment that will have all points shown on graphics page.
12. If mechanical equipment comes with a factory mounted BACnet Card, then all associated points will be broadcast back to the Honeywell JACE controller to be viewed on graphics page.
13. Provide trending on active alarms based on deviations from active setpoints to be broadcast to active alarm screen
14. Honeywell JACE controller will show active alarms and will be configured to be accessed remotely for viewing of system.
15. Provide and install all necessary open protocol software. Controller characteristics shall include 24 Vac, 60 Hz, 1 Phase power requirements, 32-degree F to 122-degree F operating environment, 512 K RAM memory, 2 MB Flash ROM, 256 K EEPROM, 12 bit resolution.

B. Control Systems Wiring:

1. All control wiring (line voltage or low voltage) required to complete the building HVAC Control System shall be provided by this Contractor in accordance with the requirements of Electrical Division Specification Sections.

2. All wiring of switches and electric-electronic control devices shall be by this Contractor.
3. Install circuits over 25-volt with color-coded No. 12 wire, minimum, in EMT.
4. Unit Controller link and Unit-to Unit Communications link wiring must be 18 AWG. twisted, shielded pair. Each conductor must be stranded tinned copper. The capacitance between the conductors must be 23 (+/-2) picofarads per foot.
5. Plenum rated cable is required for the entire installation.
6. Temperature control circuits handling 120VAC must comply with National Electrical Code (NEC) requirements in addition to State and local codes.
7. All low voltage wiring shall comply with NEC requirements in addition to State and local codes.

C. Control Panels

1. Each control panel shall be one-piece construction or individual modules fabricated together to form one panel and shall have suitable brackets for either floor or wall mounting. Each panel shall be fabricated of 16 ga. furniture steel, totally enclosed on all four sides with hinged door and key lock. Door shall be able to open either from left or right and be interchangeable in the field. The entire panel shall be factory painted with manufacturer's standard color enamel paint.
2. All control equipment shall be mounted within the panel enclosure such as relays, switches, etc.
3. Provide numbered electric terminal strips and electrical schematic drawings.
4. The following equipment shall be flush mounted on temperature control panel door:
    a) Indicating Thermometers
    b) Receiver Gauges
    c) Switches
    d) Pilot Lights
5. The alarm indicating pilot light circuit to be operable only when the controlled unit is inoperative, when it should be operative. Furnish necessary lockout devices so that false alarms do not occur.
6. Where audible alarms are called for, provide a defeat switch on the face of the panel.
7. Locations of panels on drawings are subject to change. Final locations are to be coordinated with Owner and Engineer. Panels that are relocated less that fifty (50) feet in any direction from that shown on the drawings shall not constitute an extra cost to the Owner.

D. Control Valves

1. All motorized valves shall be sized and furnished to the piping system installer under this Section for installation under this Section 23 21 13. All control valves must be guaranteed to deliver the required flow characteristics as scheduled on the drawings. Where control valves are operated in sequence with other valves they are to be equipped with positive positioning devices with adjustment for both throttling range and starting point.
2. Water control valves shall be of two-way straight through or three-way types as shown on the drawings, with polished stainless steel stems and spring-loaded Teflon packing. Valves shall be modulating except where otherwise noted on the drawings or otherwise indicated in this Section.
3. Provide position indication on valves and pilot positioners on sequenced valves. Select valves to fail safe in normally open or closed position as dictated by freeze, humidity, fire or temperature protection.
4. Provide control valves with the following characteristics:
    a) Ball Valves: Factory fabricated of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. Valves shall be Belimo

or approved equal. Close off pressure shall be at least 200 psig per valve.

b) Globe Valves 2-inch Size and Smaller: Bronze body, bronze trim, rising stem, renewable composition disk, and screwed ends with back seating capacity repackable under pressure. Valves shall be Belimo or prior approved equal. Close off pressure shall be at least 200 psig per valve.

c) Globe Valves 2 ½ -inch Size and Larger: Iron body, bronze trim, rising stem, plug-type disc, flanged ends, and renewable seat and disc. Valves shall be Belimo or prior approved equal. Close off pressure shall be at least 200 psig per valve.

d) Hydronic system globe valves shall have the following characteristics:

1) Rating: Class 125 for service at 125 psig (862 kPa) and 250 deg. F. (121 deg. C) operating conditions.

2) Internal Construction: Replaceable plugs and seats of stainless steel or brass.

3) Single-Seated Valves: Cage trim provides seating and guiding surfaces for plug on tip and bottom of guided plugs.

4) Double Seated Valves: Balanced plug, cage trim provides seating and guiding surfaces for plugs on top and bottom of guided plugs.

5) Sizing: 3 psig (21 kPa) maximum pressure drop at design flow rate.

6) Flow Characteristics: Two-way valves shall have equal percentage characteristics, three-way valves shall have linear characteristics. Operators shall close valves against pump shut-off head.

7) Valves shall be Belimo or prior approved equal.

e) Butterfly Valves: 150 psig (1035 kPa) maximum pressure differential, ASTM A126 cast iron or ASTM A536 ductile iron body and bonnet, extended neck, stainless steel stem, field-replacement EPDM or Buna N sleeve and stem seals.

f) Terminal Unit Control Valves: Bronze body, bronze trim, two-or-three-port as indicated, replaceable plugs and seats, union and threaded ends. Valves shall be Belimo or prior approved equal, with the following additional characteristics:

1) Rating: Class 125 for service at 125 psig (862 kPa) and 250 deg. F (121 deg. C) operating characteristics.

2) Sizing: 3 psig (21 kPa) maximum pressure drop at design flow rate. Close against pump shut-off head.

3) Flow Characteristics: Two-way valves shall have equal percentage characteristics, three-way valves shall have linear characteristics.

E. Control Dampers

1. All motorized control dampers shown on the drawings and required for system operation as described in this section and not being furnished with equipment shall be furnished under this section and installed under Section 23 31 13. Dampers shall be AMCA-rated, have closed-cell neoprene edges and shall have 8-inch blade widths maximum with 4’-0” maximum length of blade. Damper frames shall be constructed of two (2) hot dipped galvanized 16-gauge steel sheets welded together to form a sturdy frame section. Damper blades shall be minimum 0.0635-inch thick hot dipped galvanized steel with replaceable closed-cell neoprene seals along the blade edge. Blades shall be secured to ½-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 stainless-steel spring blade bearings, and thrust bearings at each end of every blade.

2. Dampers for outside air intake, relief and exhaust shall be guaranteed to leak less than 10 cfm per square

foot area when closed against a 4" W.G. static pressure. Operating temperature range shall be from –40 F-degrees to +200 F-degrees.

3. Two-position control dampers shall be parallel blade type sized for a minimum pressure drop at the specified duct size.
4. Modulating dampers shall be opposed blade type sized for an effective linear airflow control characteristic within the angle of rotation and maximum pressure drop specified. Provide information to the Sheet Metal Contractor for determining the proper duct relations of baffles used. Damper frames shall be formed for extra strength with mounting holes for enclosed duct mounting.
5. Size and install additional damper operators for each damper if more than one operator is required for sufficient reserve power and smooth operation. Damper motors shall be mounted adjacent to the cold ducts or housing. All damper operators used in modulating applications are to be equipped with a pilot-positioning device with adjustment for both throttling range and starting point.

F. Control Damper Actuators

1. Size each motor to operate dampers with sufficient reserve to provide smooth modulating action or two-position action as specified.
2. Provide permanent split-capacitor or shaded pole type motors with gear trains completely oil-immersed and sealed. Equip spring-return motors, where indicated on drawings or in operational sequence, with integral spiral-spring mechanism. Furnish entire spring mechanism in housings designed for easy removal for service or adjustment of limit switches, auxiliary switches, or feedback potentiometer.
3. Provide non-spring return motors for dampers larger than 25 sq. ft., and for valves larger than 2 ½-inch size, selected for running torque rating of 150 inch-pounds. Size spring-return motors for running torque rating of 150 inch-pounds, and breakaway torque rating of 150 inch-pounds.
4. Provide electronic damper actuators of the direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque and the following characteristics:
    a) Dampers: Size for running torque calculated as follows:
        1) Parallel-Blade Damper with Edge Seals: 7 inch-pounds/sq. ft. (86.8 kg-cm/sq. m) of damper.
        2) Opposed-Blade Damper with Edge Seals: 5 inch-pounds/sq. ft. (62 kg-cm/sq. m) of damper.
        3) Parallel-Blade Damper without Edge Seals: 4 inch-pounds/sq. ft. (49.6 kg-cm/sq. m) of damper.
        4) Opposed-Blade Damper without Edge Seals: 3 inch-pounds/sq. ft. (37.2 kg-cm/sq. m) of damper.
        5) Dampers with 2 to 3-inches wg (500 to 750 Pa) of pressure drop or face velocities of 1000 to 2500 FPM (5 to 13 m/s): Multiply the minimum torque above by 1.5.
        6) Dampers with 3 to 4-inches wg (750 to 1000 Pa) of pressure drop or face velocities of 2500 to 3000 FPM (13 to 15 m/s): Multiply the minimum torque above by 2.0.
    b) Coupling: V-bolt and V-shaped, toothed cradle.
    c) Overload Protection: Electronic overload or digital rotation-sensing circuitry.
    d) Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
    e) Power Requirements (Two-Position Spring Return): 120-VAC.
    f) Power Requirements (Modulating): Maximum 10 VA at 24-VAC or 8 W at 24-VDC.
    g) Proportional Signal: 2- to 10-VDC or 4 to 20 mA, and 2-to 10-VDC position feedback signal.
    h) Temperature Rating: - 22 to + 122 degree F (- 30 to + 50 degree C).
    i) Temperature Rating (Smoke and Fire/Smoke Dampers): - 22 to + 250 degree F (- 30 to + 121 degree

C).

j) Run Time: As required by application.

2.2 INSTRUMENTATION

A. Thermostats and Sensors equal to Honeywell TB7000 Series communicating Thermostats

B. Furnace Thermostat control

1. The low-voltage thermostat shall be capable of (single stage heating and cooling, multi-stage 2 heat / 2 cool, modulating heating/cooling) and shall be programmable. The thermostat shall be BACnet MS/TP communicating.

   a) Thermostat shall be equipped with large, 2 line, 16 character LCD dual intensity backlit display with three status LEDs showing FAN, HEAT, COOL.

   b) Thermostat shall achieve accurate temperature control using a PI proportional-integral algorithm. Traditional differential-based thermostats are not acceptable.

   c) Thermostat shall have an embedded local "real text" configuration utility for simplified sequence selection, start-up and configuration using an integrated five-button keypad. Thermostats requiring external configuration tools or network interface for start-up and configuration are not acceptable.

   d) Thermostat shall have an internal relative-humidity sensor as well as embedded humidification and dehumidification sequences. The thermostat shall have a 0-10Vdc analog output to control modulating humidifiers. The thermostat shall also have a discreet output (dry contact) to activate the dehumidifying sequence.

   e) Thermostat shall have ability to display the actual relative humidity directly on the LCD display.

   f) Thermostat shall have embedded outdoor reset ramp for indoor humidity and proportional discharge high limit control (outdoor air temperature sensor required).

   g) Thermostat shall have a supply relative humidity high limit setpoint to protect equipment in case of sensor failure (0-5Vdc sensor required).

   h) Thermostat shall have the ability to lockout the dehumidification sequence based on outside air temperature from –40ºF up to 122ºF, -40ºC up to 50ºC (outdoor air temperature sensor required).

   i) Thermostat shall have the option for frost protection to prevent temperatures below 42ºF (5.6ºC).

   j) Thermostat shall be supplied with BACnet MS/TP network interface. BACnet MS/TP versions shall be provided with Protocol Implementation Conformance Statement to facilitate the integration process.

   k) Thermostat shall utilize EEPROM memory to back up local configuration parameters in the event of power failure. Thermostats requiring batteries, or have no provisions for retention during loss of power shall not be acceptable.

   l) Thermostat shall support continuous, "smart" and auto-fan sequences.

   m) Thermostat shall have integrated changeover function, which will allow seamless switching between cooling and heating mode based upon temperature or network value input.

   n) Thermostat shall be capable of local or remote override during unoccupied mode. The thermostat shall resume occupied setpoints and will revert back to unoccupied setpoints after a certain amount of time (adjustable from 0 – 24hours in one hour increments).

   o) Thermostat shall have configurable temporary or permanent local override setpoints. When the "temporary setpoints" mode is enabled, once the temporary occupancy timer expires, the setpoints will revert back to their default values.

p) Thermostat shall have an adjustable deadband between heating and cooling setpoints (from 2°F to 4°F, 1°C to 2.0°C).

q) Thermostat shall have three (3) adjustable keypad lockout levels limiting access.

r) Thermostat shall have an auxiliary contact that can be used to energize peripheral devices such as lighting equipment, exhaust fans, economizers etc. This contact shall operate in parallel with the internal occupied / unoccupied schedule of the thermostat or the remote night setback contact. This auxiliary contact can be configured normally open or normally closed.

s) Thermostat shall be pre-programmed, containing all required I/O to accomplish local HVAC temperature control.

t) Thermostats shall be provided with intelligent HMI, to which will display services only as are available as switched through local digital input or network layer such as:

1) Outdoor air temperature display only enabled when outdoor air temperature sensor is connected

2) COM Address and various other parameters when a communication module is integrated inside the unit.

C. Low-Voltage, On-Off Thermostats (Cabinet Unit Heaters, Unit Heaters, Exhaust Fans with Temp Control):

1. Electric solid-state, microcomputer-based Line Voltage thermostat.

a) Automatic switching from heating to cooling.

b) Preferential rate control to minimize overshoot and deviation from set point.

c) Short-cycle protection

d) Programming based on every day of the week.

e) Selection Features Include: Deg F or Deg C display, 12-or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

f) Battery replacement without program loss.

g) Time of Day

h) Actual room temperature

i) Programmed temperature

D. Electric Low-Limit Duct Thermostat (Freezestat):

1. Snap-acting, single-pole, single-throw, manual-or automatic-reset switch that trips if temperature sensed across any 12-inches (300 mm) of bulb length is equal to or below set point.

a) Bulb Length: Minimum 20 feet (6 m).

b) Quantity: One thermostat for every 20 sq.ft. (2 sq. m) of coil surface.

E. Duct Thermostats:

1. Duct thermostats shall be supplied with liquid filled capillaries or thermistor type throughout, with the bulb of the thermostat mounted in the airflow that is being sensed and controlled. They shall be supplied with an air gauge, 1- ½" in diameter, in each branch line. A sufficient number of main air gauges shall be supplied to indicate when main air pressure is up to operating conditions. Thermostat bulbs in mixed air and discharge air locations shall be the 24' averaging type, sensing an average temperature over the total 24' of the element. Elements shall be distributed across the full air stream to sense all variations in delivered air temperature. Duct thermostats shall be readily adjustable to settings at least 5 F-degrees over and under the temperature figure specified.

F. Aquastats:

1. Provide remote thermistor or strap-on changeover type aquastats as required by sequence of operation. Aquastat shall have SPDT switching with totally enclosed contacts, external set-point adjustment with visible scale, 2-degrees F. fixed differential, and be UL listed for application. Set-point range shall be as appropriate for application. Remote thermistor aquastats shall be of the immersion type and provided with a separable well of same material as aquastat bulb. Strap-on changeover aquastats shall be provided with an adjustable pipe clamp mounting. Contact ratings shall be 2.6 FLA, 15.6 LRA for 115 VAC and 1.3 FLA, 7.8 LRA for 240 VAC electrical power.

G. Relays and Switches

1. Control Relays: Control relay contacts shall be rated for 150% of the loading application, with minimum of two (2) sets of self-wiping, snap-acting Form C contracts, enclosed in dustproof enclosure. Relays shall have silver cadmium contacts with a minimum life span rating of one million operations. Relays shall be equipped with coil transient suppression devices. Provide control relays for all 120/1-volt motors not provided with a motor starter with auxiliary contacts.

2. Solid State Relays: Input output isolation shall be greater than 1000 megohms with a breakdown voltage of 1500 Volt rms or greater at 60 Hz. Ambient range of not less than –20F to +140F. Relays shall be rated for the specific application.

3. Manual Timer Switches: Spring wound type manual timer for switching of electrical circuit at end of preset time. Provide timer with SPST switching to break circuit at end of timed period. Panel door mounting or in a 3-inch deep switch box. Timing range of 12 hours, contact rating of 20A, 125 VAC. UL listed for application.

4. Manual Wall Mounted On/Off Switches: Single pole, double throw, back and side wired switches for manual signaling or control by occupants. Contact rating of 20A, 120 VAC. with integral pilot light where indicated on the drawings or specified herein. Provide engraved cover plates to identify function.

5. Hands-off-Auto (HOA) Switches: Provide HOA switches in accordance with the requirements of Division 16 specifications sections.

H. Ionization Smoke Detectors

1. UL listed ionization smoke detectors in main return air ducts shall be furnished and wired under Electrical Division Sections and installed under this Section as directed by Electrical Contractor.

2. Duct smoke detectors shall be ionization type with air sampling assembly designed to detect invisible combustion products, fire and/or smoke in HVAC ductwork in compliance with NFPA 90A. Detector shall be plug-in type with self-compensating dual ionization chamber and solid-state amplifier switching circuit. Detector base shall be twist-lock type, with voltage range of 21 ± 3 VDC, 32 to 100° F operating temperature, 0 to 90 percent operating humidity, for 500 to 4000 fpm airflow velocity. Detector housing shall be designed for mounting on air ducts and to support sampling tubes inserted into ducts. Detector housing shall have self contained power supply and DPDT output contacts rated for 3 A at 125 VAC.

I. Time Clocks

1. Provide time clocks as required to accomplish the specified sequences of operation. Time clocks shall be microprocessor-based, solid state type with single channel time control, LCD display for time-of-day, day-of-week, and output status, and shall maintain time and program during power outage for 100 hours minimum. Provide the following programming capabilities:

   a) Seven-day plus holiday using 365-day calendar.

   b) 11 holiday durations programmable by date

   c) 18 set points programmable as either on, off, or momentary type events.

   d) Momentary duration of 1 to 59 seconds.

   e) Set points assignable to time-of-day for specific days or combination of days.

f) Automatic daylight savings changeover.

g) 12-hour (AM/PM) or 24-hour clock format.

h) Leap year correction.

i) System override from keyboard.

J. Carbon Monoxide/Nitrogen Dioxide Sensors:

1. Provide a space carbon monoxide/nitrogen dioxide (CO/NO2) sensor in the vehicle area to control the space ventilation rate based on CO/NO2 concentration levels. CO/NO2 system shall consist of Brasch Model GDCP Universal Controller with Brasch Model BGS-CM-TRNS analog carbon monoxide sensors transmitters in the parking space, or prior approved equal. Sensors shall provide a 4 to 20 ma. signal to the system controller to monitor space CO levels, with CO levels from 1 to 400 PPM range and initiate opening of outside air dampers and operate exhaust fan when CO levels rise above an operator definable level. ACM, Acme, Toxalert and Vulcain are also approved manufacturers.

2. Detector shall monitor space CO/NO2 levels, with CO levels from 1 to 25 PPM range and NO2 levels from 0.1 to 1 PPM range and send a 4 to 20 ma. signal to activate make-up air unit(s) and exhaust fan(s) when CO/NO2 levels rise above an operator defined level. ACM, Acme, and Toxalert are also approved manufacturers.

K. Air Quality Sensor:

1. Staefa Model FRA-Q1 or approved equal. The sensor shall be a heated semi-conductor. Sensor shall be self-cleaning and require no maintenance. Sensor installation and locations shall be suitable for sensing vehicle diesel fume exhaust.

L. Power Line Surge Protection: Protect equipment power supplies from power line surges.

M. Grounding Protection: Protect equipment from any ground fault by providing special grounding as required to prevent equipment failure under any kind of ground fault.

N. Fault-Tolerance: Select components to operate over a wide range of supply voltage and frequency, with static, transient and short-circuit protection on all inputs and outputs. Protect communication lines against incorrect wiring, static transients and induced magnetic interference. Provide AC coupled devices for connection to communication network to limit time-outs.

PART 3 EXECUTION

3.1 INSTALLATION OF HVAC CONTROL SYSTEMS

A. Install energy management and control systems as indicated, in accordance with system manufacturer's written instructions, and with recognized industry practices, to ensure that energy management and control equipment complies with requirements. Comply with requirements of NEC, and applicable portions of NECA's "Standard of Installation" pertaining to general electrical installation practices. Mount controllers at convenient locations and heights.

B. Coordinate with other electrical work, including power distribution and equipment, as necessary to interface installation of energy management and control equipment work with other work.

C. Control Wiring: The term "control wiring" is defined to include providing EMCS manufacturer-approved wiring, conduit and miscellaneous materials as required for mounting and connecting control devices. Conceal wiring, except in mechanical rooms and areas where other conduit and piping are exposed. Provide plenum rated multi-conductor instrument harness (bundle) in place of single conductors where number of conductors can be run along common path. Fasten flexible conductors bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support conductors neatly. Control wiring shall be plenum rated. Tees or wye taps in the communication network are not permitted.

D. Number-code and color-code conductors, excluding those used for local individual room controls, appropriately for future identification and servicing of control system. Label ends of all conductors in control cabinets with 3M tape indicating control device.

E. Install electrical terminations in UL approved, vented panel enclosures. Locate panels in spaces designated for use as electrical or mechanical equipment rooms. Panels shall be located to provide adequate access and clearance for servicing.

F. All control transformers shall be located in mechanical rooms, janitor closets, or electrical rooms exposed to view. All transformers shall be clearly labeled with the systems it serves.

G. Reset Limit Controls: Install manual-reset limit controls to be independent of power controllers.

H. Unit-Mounted Equipment: Where control devices are indicated to be unit-mounted, ship relays, switches, etc. to unit manufacturer for mounting and wiring at factory.

I. Grounding: Provide tight equipment grounding connections, sufficiently tight to assure permanent and effective ground, for energy management and control systems as indicated.

J. The TCC contractor shall be responsible for wiring of any and all remote panels, summer/winter switches, medium user interfaces, etc associated with all specified equipment as to allow complete operation and control of all equipment. Verify exact requirements with installed manufacturers equipment.

K. Provide all wiring for temperature control work whether low or line voltage in accordance with provisions of Electrical Division Sections of these specifications, unless noted otherwise.

L. Assist the systems balancing Contractor in any way possible concerning the HVAC Control Systems and Devices.

M. Upon completion of installation of system hardware and after circuitry has been energized, demonstrate capability and compliance of system with requirements. Where possible, correct malfunctioning units at site, then re-test to demonstrate compliance; otherwise remove and replace with new units, and proceed with re-testing.

1. Provide Owner-approved operation and acceptance testing of the complete system. The Owner will witness all tests

2. Field Tests: When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is place on-line. All testing, calibrating, adjusting and final field test shall be completed by the Installer. Provide a detailed crosscheck of each sensor within the system by making a comparison between the reading at the sensor and a standard based on National Bureau of Standards criteria. Provide a crosscheck of each control point within the system by making a comparison between the command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.

N. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

O. Completely adjust the entire control system. Arrange to instruct the Owner's designated personnel on the operation of the control system, provide training and supply them with three (3) copies of the control system's operating and instruction manual. Obtain from the Owner's representative a signed receipt that they have received the instruction manuals and complete instruction on the operation of the system. Furnish a framed control drawing of the complete HVAC control system to be placed near the control panel.

1. Training shall include the following:

a) Explanation of drawings, operations and maintenance manuals.

b) Walk-thru of the job to locate control components

c) Operator control functions, including field panel programming

d) Explanation of adjustment, calibration and replacement procedures.

P. If within twelve (12) months from the date of completion any of the equipment herein described is found to be defective in workmanship or materials it shall be replaced or repaired by this Contractor at no cost to the Owner.

3.2 QUALITY CONTROL

A. Upon completion of installation of system hardware and software and after circuitry has been energized, demonstrate capability and compliance of system with requirements. All testing work shall be self performed and completed by the installer and appropriate subcontractors. Where possible, correct malfunctioning units at site, then re-test to demonstrate compliance; otherwise remove and replace with new units, and proceed with re-testing.

1. Functional Performance Tests: Completion and documentation of all functional performance tests are required as a condition of substantial completion. Provide written notification to the Owner and Engineer including a copy of all testing documents that the systems are ready for the Owner's independent testing agent to begin testing. The functional performance tests shall be in checklist form and include the initials of the assigned tester and the pass date of each item to be tested. The checklists shall include but not be limited to the following:

   a) Visual inspection verifying the installation of all control components and wiring is complete.

   b) Calibration of all analog sensing devices.

   c) Conductance tests of all communication and network wiring.

   d) Visual crosscheck of each control point by making a comparison between the command and field-controlled device.

   e) Verification of loss of power and control failure modes for each control device.

   f) Verification of alarm notifications on the system front end as required in the control sequences.

   g) A checklist of deficiencies that require corrective work by other trades and an anticipated date for completion.

B. Owner's Testing: Once the functional performance test is submitted, the Owner's functional performance testing agent will re-verify performance of the system. For tests that fail, the controls contractor will be responsible to reimburse the Owner for the costs of the failed tests, or for any delays the tester endures due to the work being incomplete. The costs for re-testing will be paid for by the Contractor through deduct charge. Provide assistance and technical support as required to the Owner testing agent to accomplish all functional performance testing and system validation testing. Assistance shall include providing trend logs of any control points at the direction of the Owner's testing agent to troubleshoot system performance.

C. The BAS shall verify that all control components are installed in accordance with project requirements and are functional, including all electrical interlocks, damper sequences, air and water resets, fire and freeze stats, high and low temperature thermostats, safeties, etc.

D. The BAS Contractor shall verify that all controlling instruments are calibrated and set for design operating conditions with the exception of components that require input from the TAB Agency, but a default shall be set. The Control Contractor shall cooperate with the TAB Agency and provide all software and interfaces to communicate with the system.

E. The BAS Contractor shall thoroughly check all controls, sensors, operators, sequences, etc. before notifying the TAB Agency that the BAS is operational. The BAS Contractor shall provide technical support (technicians and necessary computers) to the TAB Agency for a complete check of these systems.

F. Prior to occupancy, each ventilation system shall be tested to ensure that OA dampers operate properly in accordance with system design.

G. Fire Alarm: Division 26 shall thoroughly check all detection devices, sequences, inter-locks, etc. before notifying the TAB Agency that the system is operational. Division 26 shall certify that the systems are totally operational to the Contract or prior to the TAB beginning.

1. The BAS contractor and Fire Alarm contractor shall coordinate all fire and smoke dampers/sensors operation with the shutdown sequence with all air handling equipment.
2. The Fire Alarm contractor shall be responsible for preparing final documentation of system integration:
3. The contractors shall review the drawings and specifications. The contractors shall establish an initial sequence of operation and matrix for all integration of system, including fire alarm sequences, HVAC fan and equipment shutdown, fan operation, damper operation, door closings, door unlocking, exhaust/makeup air systems, etc.
4. Review initial sequence of operation and matrix with mechanical and electrical engineer and owner to verify proposed system operation.
5. Provide final sequence and matrix based on actual install conditions.

3.3 GRAPHICAL USER INTERFACE

A. Provide a sample of each graphic intended for the front end user interface for review and approval by the Engineer and Owner's representative prior to final installation. The graphic must illustrate the following for review.

1. Intended procedure for navigating between graphics.
2. Sensor and control signal information available.
3. Mode of operation status, and safety information available.
4. Operator override procedures.
5. Room number and equipment designations.

B. Update final graphics with Owner requested revisions to room name and number identification and equipment identifications. Allocate time for technicians to update graphics and associated engineering drawing and as-built submittals after final installation of system software. The work shall be scheduled to occur prior to substantial completion.

C. Provide complete and entire building BAS Floor Plan and Navigation Graphics. Provide graphics for using floor plans of the building and “owner’s room numbers” at a minimum. Coordinate with the Architect/Engineer (A/E). Size graphics to allow the operator to read room numbers and descriptions. Incorporate the capability to navigate section to section as required to view entire floor and to navigate floor to floor, individual rooms, and specification equipment.

3.4 DEMONSTRATION AND TRAINING

A. Provide demonstration and training for Owner’s representative in accordance with this specification section.

B. Building Operating Personnel Training: Train Owner's building personnel in procedures for starting-up, testing and operating energy management and control system equipment. In addition, train building personnel to maintain software, that they are capable of initiating changes to computer programs including addition and deletion of points.

C. Provide competent instructors to give full instruction to designated personnel in the adjustment, operation and maintenance of the system installed rather than a general training course. Instructors shall be thoroughly familiar with all aspects of the subject matter they are to teach. All training shall be held during normal work hours of 8:00 a.m. to 4:30 p.m. weekdays as follows:

1. Provide 20 hours of on-site training for owner's operating personnel. Training shall include:
2. Explanation of drawings, operations and maintenance manuals.
3. Walk-thru of the job to locate control components.
4. Operator workstation and peripherals and operation/functions.
5. Operator control functions, including graphic generation and field panel programming
6. Operation of portable operator's terminal.
7. Explanation of adjustment, calibration and replacement procedures.

D. Provide additional 10 hours of training to be executed each quarter for a period of one year from final completion of the project.

E. Technical support staff must be made available to discuss problems as they arise, at no additional cost to the Owner.

F. Training hours shall be documented and signed off by the owner. During the onsite training hours the contractor shall also assist the owner in requested graphics programing, changes, modifications, additions, etc as determined by the owner.

G. If additional such training is required by the Owner, it will be contracted at a later date. Provide description of available local and factory customer training.

3.5 ADJUSTING AND CLEANING

A. Start-Up: Start-up, test, and adjust direct digital electronic control systems in presence of manufacturer's authorized representative. Demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

B. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

C. Final Adjustment: After completion of installation, adjust controllers, sensors and similar equipment provided as work of this section.

1. Final adjustment shall be performed by specially trained personnel in direct employ of manufacturer of primary temperature control system.

3.6 SIGNAGE

A. Provide an engraved plastic laminate sign at all push buttons in occupied spaces to identify the function of the button. Coordinate exact language of each sign with the Owner’s representative.

3.7 CLOSEOUT PROCEDURES

A. Every connected analog output (AO), analog input (AI), digital output (DO), and digital input (DI) represents a "point" where referred to in this specification. Refer to the attached data sheets for specific control sequences and for complete listing of these points. Each analog output shall have its own distinct control loop. All analog points shall be adjustable through the EMCS

B. Each air handling unit, exhaust fan, unit heater, or other equipment indicated to be controlled by a time clock schedule through the EMCS shall be capable of being individually programmed for its own schedule of operation.

PART 4 SEQUENCES OF OPERATION

4.1 FURNACE AND ASSOCIATED AIR-COOLED CONDENSING UNIT

A. This unit has gas-fired heating, direct expansion (DX) cooling and a constant volume fan. The unit shall be controllable from a dedicated remote mounted electronic programmable heating-cooling thermostat. Interlock unit operation with associated air-cooled condensing unit. Provide additional controls, control interlocks and control accessories as required for a complete and fully functioning system.

B. Control Sequences

1. Occupied Mode
   a. When in the occupied mode the fan shall run, the outside air damper shall be open to minimum position, the return air damper shall be open and the unit shall cycle on gas-fired heating or DX cooling (associated air-cooled condensing unit) as required to maintain a space temperature setpoint of 72 °F (adjustable). A mixed air low temperature limit control shall limit the mixed air temperature to a minimum of 50 °F (adjustable).

   b. On a space call for cooling when the outdoor air temperature is between 55 °F (adjustable) and 65 °F (adjustable) an economizer cooling sequence shall be initiated. During economizer cooling the gas-fired heating shall be off, the outside air damper shall be open, and the return air dampers shall modulate as required to provide up to 100% outside air as needed to maintain a 65 °F (adjustable) discharge air temperature. On a space call for additional cooling, or on a space call for cooling when the outside air temperature rises above 65 °F (adjustable), mechanical cooling shall be activated, the outside air damper shall modulate to minimum position and the DX cooling shall energize. Mechanical cooling shall operate as required to maintain a 75 °F (adjustable) space set-point temperature.

2. Unoccupied Mode
   a. When in the unoccupied mode the fan shall be off, the outside air damper shall be closed and the return air damper shall be open. When the space temperature drops below 64 °F (adjustable) and the system selector is on heating/auto setting, the system shall activate and provide heating until the space temperature reaches 71 °F (adjustable). The system shall then shutdown in accordance with the manufacturer's recommended shutdown sequence.

3. General
   a. Furnish and install a low air temperature sensor with automatic reset in the supply air duct just downstream of the furnace unit. If the discharge air temperature drops below 38 °F (adjustable), the unit shall shutdown and the outside air damper shall close.

   b. Furnish and install a high air temperature sensor with automatic reset in the supply air duct just downstream of the furnace unit. If the discharge air temperature rises above 130 °F (adjustable), the unit shall lockout gas-fired heating and the outdoor air damper shall close. The furnace shall continue to run until the manufacturer's recommended heat exchanger cool-down time has expired at which time the furnace shall shut-down.

C. Alarms

1. Generate an alarm when the supply fan control is on but the status of either supply fan is off.

2. Generate an alarm when the space temperature is 5°F above or below the setpoint for more than a 10-minute duration (all variables operator adjustable).

4.2 MECHANICAL ROOM EXHAUST FAN EF-1

A. Provide a 120V wall mounted thermostat for control of exhaust fan EF-1. When the space temperature is at or rises above 80 °F (adjustable) or below 50 °F (adjustable) the fan shall activate. When the space temperature is between 50°F and 80 °F the fan shall shutdown.

B. Alarms

1. Generate an alarm when the space temperature is 5°F above or below the setpoint for more than a 10-minute duration (all variables operator adjustable).

4.3 KITCHEN EXHAUST FANS EF-2

A. Wall switch provided by Div 26.

4.4 TOILET EXHAUST FANS EF-3

A. Fan interlocked with furnace FURN-1 operation by Div 26.

4.5 RADIANT FLOOR HEATING WATER PLANT

A. This system includes heating water boiler BLR-1, and pumps associated with the in-floor radiant heating system that serves work bay areas. Provide all required temperature sensors, flow switches, relays, contacts and other components and accessories as required for a complete and fully functioning heating water plant.

B. When the outdoor air temperature drops below 40-degrees F (adjustable) the boiler plant shall be enabled and activate. The main boiler circulation pumps shall start and the boilers shall stage on as required to maintain a 130-degree F heating water supply temperature.

C. Provide a space thermostat and control valve for each heating zone. Verify exact requirements with the installed radiant heating manufacturer.

D. Provide all necessary boiler heating plant controls and safeties for a complete and fully functioning heating water plant. Provide an emergency boiler shutdown button for the boiler room. Locate button in accordance with State code requirements.

E. Alarms

1. Generate an alarm if Boiler is in failure mode.

4.6 GAS FIRED UNIT HEATERS

A. Provide a single or two stage heating thermostat as appropriate for unit heaters.

4.7 EXHUAST FANS EF-4 THRU 6 (VEHICLE AREAS)

A. These fans shall be individually activated by a high CO/NO2 level or manual override. Interlock fan operation with outdoor air intake damper operation such that if any fan operates, the outdoor air intake damper opens. Damper actuator to be 120V and wired by Div 26.

B. Control Sequences

1. High CO/NO2 System Activation

   a. At any time (occupied or unoccupied mode) that a CO/NO2 sensor detects CO/NO2 levels above an operator defined and fully adjustable set point, fan shall activate.

2. Manual Activation

   b. Provide a manual switch with a 60-minute timer (adjustable).

C. Alarms

1. Generate an alarm if any of the exhaust fans are indicated to run but their status is off.

2. Generate an alarm if any of the carbon monoxide or nitrogen dioxide sensors are sensing conditions outside of their acceptable parameters for a time period greater than 30 minutes.

4.8 TRANSFER FAN TF-1

A. Provide a 120V wall mounted thermostat for control of transfer fan TF-1. When the space temperature is at or rises above 72 °F (adjustable) the fan shall activate.

END OF SECTION 23 09 00

SECTION 23 11 23

NATURAL-GAS PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. Section Includes:

1. Pipes, tubes, and fittings.
2. Piping specialties.
3. Piping and tubing joining materials.
4. Valves.
5. Pressure regulators.
6. Service meters.
7. Mechanical sleeve seals.
8. Grout.
9. Concrete bases.

1.03 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed Space: A space that does not have an opening through its boundary to allow the free passage of air to an occupied space. The opening size and location within the space boundary required for a space to be considered non-concealed is at the discretion of the Engineer and the plumbing inspector. The measure of a space that is defined as non-concealed is that odors from a potential gas leak will be readily detected by a building occupant.

1.04 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

1. Piping and Valves: 100 psig minimum unless otherwise indicated.
2. Service Regulators: 65 psig minimum unless otherwise indicated.

B. Natural-Gas System Pressures within Buildings: Two pressure ranges. Primary pressure is more than 0.5 psig but not more than 2 psig, and is reduced to secondary pressure of 0.5 psig or less.

1.05 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of the following:

1. Piping specialties.
2. Corrugated, stainless-steel tubing with associated components.
3. Valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
4. Pressure regulators. Indicate pressure ratings and capacities.
5. Dielectric fittings.
6. Mechanical sleeve seals.
7. Escutcheons.

C. Welding certificates.

D. Field quality-control reports.

E. Operation and Maintenance Data: For motorized gas valves and pressure regulators to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and dispose of liquids from existing natural-gas piping according to requirements of authorities having jurisdiction.

B. 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.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

1.08 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Interruption of Existing Natural-Gas Service: Do not interrupt natural-gas service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide purging and startup of natural-gas supply according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of natural-gas service.

1.09 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

B. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces. Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2: PRODUCTS

2.01 PIPES, TUBES, AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M for butt welding and socket welding.

3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

4. Forged-Steel Flanges and Flanged Fittings: ASME B16.5, minimum Class 150, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

   a. Material Group: 1.1.

   b. End Connections: Threaded or butt welding to match pipe.

   c. Lapped Face: Not permitted underground.

   d. Gasket Materials: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

   e. Bolts and Nuts: ASME B18.2.1, carbon steel aboveground and stainless steel underground.

B. Galvanized Steel Pipe and Fittings: Conform to ASTM A53/A 53M, Type E or S, Grade A or B, Schedule 40.

1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.

2. Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, galvanized, seamless steel pipe. Include ends matching joining method.

3. Malleable-Iron Unions: ASME B16.39; Class 150; hexagonal-stock body with ball-and-socket, metal-to-metal, bronze seating surface; and female threaded ends.

C. Drawn-Temper Copper Tube: Comply with ASTM B 88, Type K.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.

2. Bronze Flanges and Flanged Fittings: ASME B16.24, Class 150.

   a. Gasket Material: ASME B16.20, metallic, flat, asbestos free, aluminum o-rings, and spiral-wound metal gaskets.

   b. Bolts and Nuts: ASME B18.2.1, carbon steel or stainless steel.

D. Annealed-Temper Copper Tube: Comply with ASTM B 88, Type K.

1. Copper Fittings: ASME B16.22, wrought copper, and streamlined pattern.

2.02 PIPING SPECIALTIES

A. Appliance Flexible Connectors:

1. Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.
2. Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.
3. Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.
4. Corrugated stainless-steel tubing with polymer coating.
5. Operating-Pressure Rating: 0.5 psig.
6. End Fittings: Zinc-coated steel.
7. Threaded Ends: Comply with ASME B1.20.1.
8. Maximum Length: 72 inches.

B. Quick-Disconnect Devices: Comply with ANSI Z21.41.

1. Copper-alloy convenience outlet and matching plug connector.
2. Nitrile seals.
3. Hand operated with automatic shutoff when disconnected.
4. For indoor or outdoor applications.
5. Adjustable, retractable restraining cable.

C. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

D. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

E. T-Pattern Strainers:

1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
4. CWP Rating: 750 psig.

F. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.03 JOINING MATERIALS

A. Joint Compound and Tape: Suitable for natural gas.

B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

C. Brazing Filler Metals: Alloy with melting point greater than 1000 deg F complying with AWS A5.8/A5.8M. Brazing alloys containing more than 0.05 percent phosphorus are prohibited.

2.04 MANUAL GAS SHUTOFF VALVES

A. General Requirements for Metallic Valves, NPS 2 and Smaller: Comply with ASME B16.33.

1. CWP Rating: 125 psig.

2. Threaded Ends: Comply with ASME B1.20.1.

3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.

4. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Listing: Listed and labeled by an NRTL acceptable to authorities having jurisdiction for valves 1 inch and smaller.

6. Service Mark: Valves 1-1/4 inches to NPS 2 shall have initials "WOG" permanently marked on valve body.

B. General Requirements for Metallic Valves, NPS 2-1/2 and Larger: Comply with ASME B16.38.

1. CWP Rating: 125 psig

2. Flanged Ends: Comply with ASME B16.5 for steel flanges.

3. Tamperproof Feature: Locking feature for valves indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

4. Service Mark: Initials "WOG" shall be permanently marked on valve body.

C. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. BrassCraft Manufacturing Company; a Masco company.
   b. Conbraco Industries, Inc.; Apollo Div.
   c. Lyall, R. W. & Company, Inc.
   d. McDonald, A. Y. Mfg. Co.
   e. Perfection Corporation; a subsidiary of American Meter Company.

2. Body: Bronze, complying with ASTM B 584.

3. Ball: Chrome-plated bronze.

4. Stem: Bronze; blowout proof.

5. Seats: Reinforced TFE; blowout proof.

6. Packing: Threaded-body packnut design with adjustable-stem packing.

7. Ends: Threaded, flared, or socket as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

8. CWP Rating: 600 psig.

9. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

10. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

D. Bronze Plug Valves: MSS SP-78.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Lee Brass Company.
b. McDonald, A. Y. Mfg. Co.

2. Body: Bronze, complying with ASTM B 584.

3. Plug: Bronze.

4. Ends: Threaded, socket, or flanged as indicated in "Underground Manual Gas Shutoff Valve Schedule" and "Aboveground Manual Gas Shutoff Valve Schedule" Articles.

5. Operator: Square head or lug type with tamperproof feature where indicated.

6. Pressure Class: 125 psig.

7. Listing: Valves NPS 1 and smaller shall be listed and labeled by an NRTL acceptable to authorities having jurisdiction.

8. Service: Suitable for natural-gas service with "WOG" indicated on valve body.

2.05 MOTORIZED GAS VALVES

A. Automatic Gas Valves: Comply with ANSI Z21.21.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eaton Corporation; Controls Div.
d. Eclipse Combustion, Inc.
e. Honeywell International Inc.
f. Johnson Controls.

2. Body: Brass or aluminum.
3. Seats and Disc: Nitrile rubber.
4. Springs and Valve Trim: Stainless steel.
5. Normally closed.
6. Visual position indicator.
7. Electrical or Mechanical operator for actuation by appliance automatic shutoff device.

B. Electrically Operated Valves: Comply with UL 429.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. ASCO Power Technologies, LP; Division of Emerson.
b. Dungs, Karl, Inc.
c. Eclipse Combustion, Inc.
d. Goyen Valve Corp.; Tyco Environmental Systems.
e. Magnatrol Valve Corporation.
f. Parker Hannifin Corporation; Climate & Industrial Controls Group; Skinner Valve Div.
g. Watts Regulator Co.; Division of Watts Water Technologies, Inc.

2. Pilot operated.
3. Body: Brass or aluminum.
4. Seats and Disc: Nitrile rubber.
5. Springs and Valve Trim: Stainless steel.
6. 120-V ac, 60 Hz, Class B, continuous-duty molded coil, and replaceable.
7. NEMA ICS 6, Type 4, coil enclosure.
8. Normally closed.
9. Visual position indicator.

2.06 PRESSURE REGULATORS

A. General Requirements:

1. Single stage and suitable for natural gas.
2. Steel jacket and corrosion-resistant components.
3. Elevation compensator.
4. End Connections: Threaded for regulators NPS 2 and smaller; flanged for regulators NPS 2-1/2 and larger.

B. Service Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Actaris.
   b. American Meter Company.
   c. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   d. Invensys.
   e. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Optional features:

    a. Overpressure Protection Device: Factory mounted on pressure regulator.

    b. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

    c. Maximum Inlet Pressure: 100 psig.

C. Line Pressure Regulators: Comply with ANSI Z21.80.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Actaris.
   b. American Meter Company.
   c. Eclipse Combustion, Inc.
   d. Fisher Control Valves and Regulators; Division of Emerson Process Management.
   e. Invensys.
   f. Maxitrol Company.
   g. Richards Industries; Jordan Valve Div.

2. Body and Diaphragm Case: Cast iron or die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

6. Orifice: Aluminum; interchangeable.

7. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

8. Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

9. Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

10. Optional Features:

    a. Overpressure Protection Device: Factory mounted on pressure regulator.

    b. Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

    c. Maximum Inlet Pressure: 2 psig

D. Appliance Pressure Regulators: Comply with ANSI Z21.18.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Canadian Meter Company Inc.
   b. Eaton Corporation; Controls Div.
   c. Harper Wyman Co.
   d. Maxitrol Company.
   e. SCP, Inc.

2. Body and Diaphragm Case: Die-cast aluminum.

3. Springs: Zinc-plated steel; interchangeable.

4. Diaphragm Plate: Zinc-plated steel.

5. Seat Disc: Nitrile rubber.

6. Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

7. Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

8. Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

9. Maximum Inlet Pressure: 2 psig.

2.07 DIELECTRIC FITTINGS

A. Dielectric Unions:

1. Minimum Operating-Pressure Rating: 150 psig.

2. Combination fitting of copper alloy and ferrous materials.

3. Insulating materials suitable for natural gas.

4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

B. Dielectric Flanges:

1. Minimum Operating-Pressure Rating: 150 psig.

2. Combination fitting of copper alloy and ferrous materials.

3. Insulating materials suitable for natural gas.

4. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

C. Dielectric-Flange Kits:

1. Minimum Operating-Pressure Rating: 150 psig.

2. Companion-flange assembly for field assembly.

3. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or PE bolt sleeves, phenolic washers, and steel backing washers.

4. Insulating materials suitable for natural gas.

5. Combination fitting of copper alloy and ferrous materials with threaded, brazed-joint, plain, or welded end connections that match piping system materials.

2.08 SLEEVES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.09 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe and sleeve.

2. Pressure Plates: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one nut and bolt for each sealing element.

2.10 ESCUTCHEONS

A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube, and OD that completely covers opening.

2.11 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.

2.12 LABELING AND IDENTIFYING

A. Detectable Warning Tape: Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored yellow.

PART 3: EXECUTION

3.01 PIPE APPLICATIONS

A. Within Building: Install steel pipe with welded joints for all pipe sizes. Steel pipe with threaded joints or copper pipe with brazed joints, may be installed for 2” and smaller piping where routed in locations not defined as a concealed space.

B. Outside Building: Install galvanized steel pipe with threaded joints and fittings.

3.02 ABOVEGROUND MANUAL GAS SHUTOFF VALVE SCHEDULE

A. Valves for pipe sizes NPS 2 and smaller shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.
2. Bronze plug valve.

B. Valves for pipe sizes NPS 2-1/2 and shall be one of the following:

1. Two-piece, full-port, bronze ball valves with bronze trim.

2. Bronze plug valve.
3. Cast-iron, nonlubricated plug valve.

3.03 PIPING JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints:

1. Thread pipe with tapered pipe threads complying with ASME B1.20.1.

2. Cut threads full and clean using sharp dies.

3. Ream threaded pipe ends to remove burrs and restore full inside diameter of pipe.

4. Apply appropriate tape or thread compound to external pipe threads unless dryseal threading is specified.

5. 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.

D. Welded Joints:

1. Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators.

2. Bevel plain ends of steel pipe.

3. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

F. Flanged Joints: Install gasket material, size, type, and thickness appropriate for natural-gas service. Install gasket concentrically positioned.

3.04 EXAMINATION

A. Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.05 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to State Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with State Code requirements for prevention of accidental ignition.

3.06 OUTDOOR PIPING INSTALLATION

A. Comply with State Code for installation and purging of natural-gas piping.

B. Install underground, natural-gas piping buried at least 36 inches below finished grade. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

1. If natural-gas piping is installed less than 36 inches below finished grade, install it in containment conduit.

C. Steel Piping with Protective Coating:

1. Apply joint cover kits to pipe after joining to cover, seal, and protect joints.
2. Repair damage to coating on pipe as recommended in writing by protective coating manufacturer.

D. Install fittings for changes in direction and branch connections.

E. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.

F. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

G. Install pressure gage downstream from each service regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.07 INDOOR PIPING INSTALLATION

A. Comply with State Code for installation and purging of natural-gas piping.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.

D. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

E. 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.

F. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

G. Locate valves for easy access.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install escutcheons at penetrations of interior walls, ceilings, and floors. Escutcheons in areas exposed to view shall have a chrome plated finish.

K. Seal space outside of sleeves in concrete slabs and walls with grout.

L. Install sleeves that are large enough to provide ¼-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

M. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.

2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe.

    a. Extend sleeves 2 inches above finished floor level.

    b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section “Sheet Metal Flashing and Trim” for flashing.

3. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.

4. Sleeves for Piping Passing through Exterior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).

    b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.

    c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

5. Sleeves for Piping Passing through Interior Concrete Walls:

    a. Steel pipe sleeves for pipes smaller than NPS 6.

N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

O. Verify final equipment locations for roughing-in.

P. Comply with requirements in Sections specifying gas-fired appliances and equipment for roughing-in requirements.

Q. Drips and Sediment Traps: Install drips at points where condensate may collect, including service-meter outlets. Locate where accessible to permit cleaning and emptying. Do not install where condensate is subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use nipple a minimum length of 3 pipe diameters, but not less than 3 inches long and same size as connected pipe. Install with space below bottom of drip to remove plug or cap.

R. Extend relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

S. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels unless indicated to be exposed to view.

T. Concealed Space: In accordance with the definition in Part 1, the following conditions are considered to be concealed spaces. The following is not intended to be a complete list of all concealed conditions within the building. All piping in a concealed space shall have welded joints and fittings. Mechanical fittings, valves, and unions are not allowed.

1. Above-Ceiling Locations: That are not return plenums or do not have a reasonably sized and located opening to allow free passage of air to the occupied space below.

2. Piping In Partitions: Piping routed in partition walls shall be open to a non-concealed ceiling space and allow the free passage of air for the entire height of the partition.

U. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumb waiter, elevator shafts within poured concrete floors, or below grade within the building perimeter.

V. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

W. Connect branch piping from top or side of horizontal piping.

X. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment. Unions are not required at flanged connections.

Y. Do not use natural-gas piping as grounding electrode.

Z. Install strainer on inlet of each line-pressure regulator and automatic or electrically operated valve.

AA. Install pressure gage downstream from each line regulator. Pressure gages are specified in Division 23 Section "Meters and Gages for HVAC Piping."

3.08 SERVICE-METER

A. Coordinate with the local utility for new service meter installation or for required modifications to the existing meter.

B. The mechanical contractor shall contact the local utility and verify that the required gas pressure, flow and meter size is provided to serve the new system. The mechanical contractor shall coordinate with the local utility in order to insure all necessary changes to the system are preformed prior to start-up of the building system.

3.09 VALVE INSTALLATION

A. Install manual gas shutoff valve for each gas appliance ahead of corrugated stainless-steel tubing, aluminum, or copper connector.

B. Install regulators and overpressure protection devices with maintenance access space adequate for servicing and testing.

C. Locate gas pressure regulator a minimum distance of 5’-0” from all air handling equipments’ furnace burner exhausts.

3.10 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install supports for vertical copper tubing every 10 feet.

C. Install supports for vertical steel piping every 15 feet.

D. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾"	4	4	3/8
1" to 2"	6	6	3/8
2½" to 4"	6	6	½
5" and Greater	4	4	7/8

E. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions and prior approved spacing by the structural engineer.

F. Provide Anvil-Strut HBS roller series roof support system for all piping on roof.

3.11 CONNECTIONS

A. Install piping adjacent to appliances to allow service and maintenance of appliances.

B. Connect piping to appliances using manual gas shutoff valves and unions. Install valve within 72 inches of each gas-fired appliance and equipment. Install union between valve and appliances or equipment.

C. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance.

3.12 LABELING AND IDENTIFYING

A. Comply with requirements in Division 23 Section "Identification for HVAC Piping and Equipment" for piping and valve identification.

3.13 PAINTING

A. Comply with requirements in Division 09 painting Sections for painting interior and exterior natural-gas piping.

3.14 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to State Code and authorities having jurisdiction.

C. Natural-gas piping will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 23 11 23

SECTION 23 21 13

HYDRONIC PIPING

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 GENERAL REQUIREMENTS

A. Construct all piping systems in accordance with applicable ASME Codes

B. Piping shall be installed parallel to building coordinates with vertical drops. Piping in the vicinity of equipment shall be arranged to not interfere with access panels and maintenance space. Provide unions, flanges and shutoff valves to allow removal of the equipment and its subassemblies without having to remove excessive amounts of building piping and to minimize water drainage requirements. Provide a vent valve at the topmost part and a drain valve at the lowest part of all water piping systems. Bull head Tee arrangement is not acceptable

C. All piping, fittings and valves shall be manufactured in the United States of America.

D. Provide pipe sleeves for all insulated piping passing through a wall and all piping passing through a floor above grade.

1.04 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Makeup-water piping.
3. Condensate-drain piping.
4. Air-vent piping.
5. Safety-valve-inlet and -outlet piping.

B. Related Sections include the following:

1. Division 23 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.

1.05 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 150 psig at 200 deg F.
2. Makeup-Water Piping: 80 psig at 150 deg F.
3. Air-Vent Piping: 200 deg F.
4. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.06 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.

2. Air control devices.

3. Chemical treatment.

4. Hydronic specialties.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports including reports on flushing procedures and hydrostatic pressure testing.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site and recommendation of the chemical treatment consultant.

1.07 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

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. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2: PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.

2.02 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

E. Installation-Ready fittings for Schedule 10 through Schedule 80 plain end carbon steel piping: NPS ½" thru 2". System rated for a working pressure of 300 psi. Fittings shall consist of a ductile iron housing conforming to ASTM A536, Grade 65-45-12, with Installation-Ready ends. Fittings complete with gasket liner, zinc-electroplated steel bolts and nuts as per the mechanical properties of ASTM A449, and 300 series stainless steel retainer. Eqyal to Victaulic QuickVic SD.

F. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in Part 3 "Piping Applications" Article.

G. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

H. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.
2. End Connections: Butt welding.
3. Facings: Raised face.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.03 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.04 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper-alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions:

1. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

1. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.

E. Dielectric-Flange Kits:

1. Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures

F. Dielectric Couplings:

1. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

1. Electroplated steel nipple or ductile iron casing with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Bronze, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Armstrong Pumps, Inc.
b. Flow Design Inc.
c. Gerand Engineering Co.
d. Griswold Controls.
e. Taco.
f. Victaulic / Tour & Andersson.

2. Body: Bronze or Ametal (copper-alloy), globe, ball, or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE or EPDM.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Handwheel with readout or lever, with memory stop to retain set position.
9. CWP Rating: Minimum 250 psig.
10. Maximum Operating Temperature: 230 deg F.
11. Coil-Hook-up Connections: Equal to Victaulic Koil-Kits Series 799 or 79V may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve, Series 78Y Strainer-Ball, Series 78U Union-Port fitting, with Series 78T ball valve and required coil hoses. A Style 793 and/or 794 differential

pressure controller shall be provided as required. A meter shall be provided by the valve manufacturer that shall remain with the building owner after commissioning.

C. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Armstrong Pumps, Inc.
    b. Flow Design Inc.
    c. Gerand Engineering Co.
    d. Griswold Controls.
    e. Taco.
    f. Tour & Andersson; available through Victaulic Company of America.

2. Body: Ductile-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Ametal or glass and carbon-filled PTFE.
6. Seat: PTFE or EPDM.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Handwheel with readout or lever, with memory stop to retain set position.
10. CWP Rating: Minimum 250 psig.
11. Maximum Operating Temperature: 230 deg F

D. Liquid Flow Switches

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    a. McDonald Miller

2. Brass construction for all wetted parts.
3. Packless construction.
4. Paddle with removable segments for pipe size and velocity.
5. Vapor-proof electrical compartment for switches.

E. Pressure/Temperature Safety Relief Valves.

1. Bronze body with test lever, EPDM diaphragm and seat.
2. ASME rated.
3. Pressure relief valve set at 30-psig pressure.
4. Maximum working pressure of 125 psig.
5. Maximum operating temperature of 250-degree F.
6. Bell & Gossett Series 790, 1170, 3301, or 4100 as applicable.

F. Flexible Pump Connectors

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Mason
    b. La Favorite
    c. Resistoflex
    d. Victaulic.

2. Flanged Type

    a. Neoprene and duck construction of molded teflon.
    b. Control rods in accordance with manufacturer’s published instructions.

c. Rated for 225-degree F. temperature and 100-psig pressure.

G. Flexible Corrugated Metal Hose

1. Bronze with annular or helical corrugations
2. Single bronze braid covering with threaded end connections.
3. 1" offset motion each side of centerline.
4. Pressure rating of 200 psig.
5. Temperature rating of 250-degree F.
6. All piping connections to equipment with spring isolation shall have flexible pipe connector at all connections to equipment whether specifically shown on drawings or not.

H. Calibrated Balance Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Victaulic
   b. Armstrong
   c. Tour Anderson
   d. Barco
   e. Amtrol

2. Non-ferrous, bronze body

   a. ½"-2" threaded or sweat fitting.
   b. Larger than 2" shall have flanged fitting.

3. Positive shutoff rising stem angled globe style design.
4. Double packing to allow service under pressure.
5. Plug tap connections both sides of valve for portable meter.
6. Calibrated memory stop with locking feature.
7. 4-turn (1440-degree) throttling range.
8. Brass tags with flow and meter setting.
9. Size valves for 1 ft. P.D. at 50% open.

I. Flow Measuring Devices- Pitot Tube Type

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Gerand
   b. Rinco
   c. KG Co.

2. Averaging type flow element constructed of 316 stainless steel.

3. Consists of three (3) flow sensing chambers

   a. Upstream high-pressure chamber.
   b. High pressure interpolating tube.
   c. Single downstream low pressure located on pipe centerline.

4. Accuracy shall be within ± 1% of actual value and ± 0.1% repeatability with flow rates scheduled on the drawings.

5. Provide the following accessories:

   a. Shutoff instrument valves.

b. Permanent metal tag indicating design flow rates, meter readings, tag number.
c. Flow indicator chart framed under glass and showing tag number, location, and design flow rate.
d. Meter complete with case, hoses and shutoff valves. Turn over to owner at project completion.
   1) Furnish a portable 0 - 50 inch differential pressure meter for balancing. Meter shall be equal to Gerrand Company, Model M-50 , complete with 6 inch dial, steel case, 10 foot meter hoses with disconnect ends, purge valves, blowdown hoses and operating instruction sheet. Meter assembly shall be rated for 250 psig and 250o F.

2.06 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Amtrol, Inc.
2. Armstrong Pumps, Inc.
3. Bell & Gossett Domestic Pump; a division of ITT Industries.
4. Taco.

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: **NPS 1/8**.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

D. Diaphragm or Bladder Type Expansion Tanks:

1. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

2. Diaphragm or Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.

3. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.

2.07 CHEMICAL TREATMENT

A. Bypass Chemical Feeder: Welded steel construction; 125-psig working pressure; 5-gal. capacity; with fill funnel and inlet, outlet, and drain valves. Equal to Aqua Pass Plus 8759. Provide at each heating water and cooling water system.

1. Chemicals: Specially formulated, based on analysis of makeup water, to prevent accumulation of scale and corrosion in piping and connected equipment.

B. Ethylene and Propylene Glycol: Industrial grade with corrosion inhibitors and environmental-stabilizer additives for mixing with water in all systems (new and existing) indicated to contain antifreeze or glycol solutions.

2.08 SLEEVES

A. Cast-Iron Wall Pipes: Fabricated of cast iron, and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

C. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

1. Underdeck Clamp: Clamping ring with setscrews.

2.09 SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.

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: Stainless steel.

3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.010 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body:
   a. ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   b. ASTM A 536, Grade 65-45-12, ductile iron with coupled cover and drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent total free area.
4. CWP Rating: 300 psig.

B. Basket Strainers:

1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

C. T-Pattern Strainers:

1. Body:
   a. Ductile-iron with removable access coupling and end cap for strainer maintenance.
   b. Factory-fabricated steel with T-bolt hinged closure for strainer maintenance.
2. End Connections: Grooved ends.
3. Strainer Screen: 40 mesh startup strainer, and perforated stainless-steel basket with-2:1 total free area.
4. CWP Rating: 300 psig.

D. Stainless-Steel Bellow, Flexible Connectors:

1. Body: Stainless-steel bellows with woven, flexible, bronze, wire-reinforcing protective jacket.
2. End Connections: Threaded or flanged to match equipment connected.
3. Performance: Capable of 3/4-inch misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

E. Spherical, Rubber, Flexible Connectors:

1. Body: Fiber-reinforced rubber body.
2. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
3. Performance: Capable of misalignment.
4. CWP Rating: 150 psig.
5. Maximum Operating Temperature: 250 deg F.

F. Expansion fittings are specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

2.011 HYDRONIC PIPING MINIMUM RUNOUT PIPE SIZING TO EQUIPMENT

A. Unless noted otherwise on the plans, pipe runout sizes for vav boxes reheat coils, hydronic coils, unit heaters, fintube radiation, etc shall be of the size indicated below:

PIPE SIZE	MBH	GPM
1/2"	0 - 20.0	0 - 2.0
3/4"	21.0 - 40.0	2.1 - 4.0
1"	41.0 - 75	4.1 - 7.5
1-1/4"	76.0 - 110.0	7.6 - 17.0
1-1/2"	111.0 - 170.0	11.1 - 17.0
2"	171.00 - 370.0	17.1 - 37.0

PART 3: EXECUTION

3.01 PIPING APPLICATIONS

A. Hydronic Piping (unless otherwise specified here-in):

1. Up to 2”: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

B. Makeup-water piping:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

C. Condensate-Drain Piping: Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

D. Air-Vent Piping:

1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.

2. Outlet: Type K, annealed-temper copper tubing with soldered or flared joints.

E. Safety-Valve-Inlet and -Outlet Piping for Hot-Water Piping: Same materials and joining methods as for piping specified for the service in which safety valve is installed.

3.02 VALVE APPLICATIONS

A. Refer to section 23 05 23 for additional valving requirements.

B. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

C. Provide ball valve type isolation shutoff valve at all branch supply and return lines where the piping branches are taken from another piping main whether specifically shown on the plans or not and as required for balancing and system isolation. Provide whether specifically shown on the plans or not.

D. Provide shutoff valves located in new and or existing piping system as required to isolate areas/systems to all for demolition and installation of new system where required to maintain operation of existing areas.

E. Locate shutoff valve outside of toilet room area and within an accessible space.

F. Install calibrated-orifice, balancing valves at each branch connection to return main.

G. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

H. Install check valves at each pump discharge and elsewhere as required to control flow direction.

I. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01, for installation requirements.

J. Manual Vent Valves

1. Install manual vent valves on each hydronic terminal at highest point.
2. Install at each high point in the piping system which could trap air.

K. Automatic Vent Valves

1. Install automatic vent valves at top of each hydronic riser and elsewhere as indicated.
2. Install shutoff valves between riser and vent valve, pipe outlet to suitable plumbing drain, or as indicated.

L. Dip Tube Fittings

1. Install dip tube fittings in boiler outlet in accordance with manufacturer’s most current published installation instructions.
2. Run piping to expansion tank with ¼” per foot (2%) upward slope towards tank.
3. Connect boiler outlet piping.

M. Pump Discharge Valves

1. Install on each pump discharge line.
2. Install in horizontal or vertical position with stem in upwards position.
3. Allow clearance above stem for check mechanism removal.

N. Liquid Flow Switches

1. Install in horizontal pipe with switch mounted in tee on top of pipe.
2. Minimum of 24” of straight pipe with no fittings both upstream and down stream of switch.
3. Remove segments of paddle to fit pipe in accordance with manufacturer’s most current published installation instructions.

4. Wiring of liquid flow switches is specified in Electrical sections.

O. Pressure/Temperature Safety Relief Valves

1. Install on hot water generators, and elsewhere as indicated.
2. Pipe discharge to floor drain.
3. Comply with ASME Boiler and Pressure Vessel Code criteria.

P. Flexible Corrugated Metal Hose

1. Install in supply and return connections to coils and unit heaters in vertical or horizontal position and at right angle to the supply mains.
2. Flow Measuring Devices
3. Install in accordance with manufacturer's most current published installation instructions.
4. All piping connections to equipment with spring isolation shall have flexible pipe connector at all connection to equipment

3.03 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. 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.

D. Contractor is responsible for coordination with other trades and systems

E. No pipe shall pass in front of or interfere with any openings, door or window. Head room in front of openings and doors shall in no case be less than the top of the opening.

F. Piping shall not pass exposed through electrical rooms or be erected over any switchboard or other electrical gear.

1. Where conflicts are unavoidable, stainless steel drain pans with drain lines piped to an approved waste receptor may be provided, pending written approval from the Owner.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve servicing.

I. Install piping at indicated slopes.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install piping to allow application of insulation.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

O. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

P. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

Q. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

R. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping.

S. Install unions in piping**,** NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

T. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

U. Unions and flanges for servicing and disconnect are not required in installations using grooved joint couplings. (The couplings shall serve as disconnect points.)

V. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

W. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

X. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

Y. Install all temperature sensors and flow switches at the direction of the Building Automation System Contractor.

Z. Identify piping as specified in Division 23 Section “Identification for HVAC Piping and Equipment.”

AA. Install automatic air vents with isolation valve at the highest point in each system. Air vent shall be rated for the system temperature, pressure and water chemistry. Where feasible, automatic air vents installed in glycol systems must be routed to the main recovery tank.

BB. All piping shall be arranged to completely drain the system. Drain locations shall be located at all system low points. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

CC. Reduced pressure principal back flow preventers shall be installed on all make-up water lines.

DD. Bull-heading tee connections are prohibited. Main fluid flows shall not enter the side of a tee fitting and then diverge.

3.04 HANGERS AND SUPPORTS

A. Comply with requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.

3. Multiple, Straight, Horizontal Piping Runs: Field fabricated, heavy duty trapeze. Fabricate from steel shapes and rod diameters as required for loads per MSS SP-58 and MSS SP-69. Verify rod diameter with structural engineer for multiple pipe trapeze hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install supports for vertical copper tubing every 10 feet.

E. Install supports for vertical steel piping every 15 feet.

F. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾"	4	4	3/8
1" to 2"	6	6	3/8
2½" to 4"	6	6	½
5" and Greater	4	4	7/8

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions and prior approved spacing by the structural engineer.

3.05 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 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.

3.06 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting, including any areas up and downs of pipe routing causing “trapping”.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.

D. Install in-line air separators in pump suction. Install drain valve on air separators NPS 2 and larger.

E. Install tangential air separator in pump suction. Install blowdown piping with gate or full-port ball valve; extend full size to nearest floor drain.

F. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 23 Section "Meters and Gages for HVAC Piping."

E. Install control valves in accessible locations close to connected equipment. Install ports for pressure gages and thermometers at coil inlet and outlet connections. Comply with requirements in Section 230519 "Meters and Gages for HVAC Piping."

F. Provide unions and arrangement of sufficient length of removable sections of tubing at valves and equipment connections to allow for easy removal and reinstallation for repairs without having to redo press connections.

G. Make piping connections to coils and equipment with offsets provided with screwed or flanged unions so arranged that the equipment can be serviced or removed without dismantling the piping. Do not screw unions directly to coil or tube header piping connections.

3.08 CHEMICAL TREATMENT

A. Provide the services of a chemical treatment consultant to perform an analysis of makeup water to determine type and quantities of chemical treatment needed to keep system free of scale, corrosion, and fouling, and to sustain the following water characteristics. Submit a report to the Engineer to include the initial water analysis and the consultants recommendations.

1. pH: 9.0 to 10.5
2. "P" Alkalinity: 100 to 500 ppm.
3. Boron: 100 to 200 ppm.
4. Chemical Oxygen Demand: Maximum 100 ppm. Modify this value if closed system contains glycol.
5. Corrosion Inhibitor:
    a. Sodium Nitrate: 1000 to 1500 ppm
6. Soluble Copper: Maximum 0.20 ppm
7. Tolyiriazole Copper and Yellow Metal Corrosion Inhibitor: Minimum 10 ppm.
8. Total Suspended Solids: Maximum 10 ppm.
9. Ammonia: Maximum 20 ppm.
10. Free Caustic Alkalinity: Maximum 20 ppm.
11. Microbiological Limits:
    a. Total Aerobic Plate Count: Maximum 1000 organisms/ml.
    b. Total Anaerobic Plate Count: Maximum 100 organisms/ml.
    c. Nitrate Reducers: 100 organisms/ml.
    d. Sulfate Reducers: Maximum 0 organisms/ml.
    e. Iron Bacteria: Maximum 0 organisms/ml.

B. The entire new and existing hydronic system shall be flush and cleaned a minimum of (2) two after all new work has been completely. Additional flush/cleaning/treatments shall be required if specification requirement cannot be meet with first two cleanings. This work shall include cleaning of all strainers.

1. The contractor shall provide a pre and post flush/clean/treatment report for each cleaning.

C. Fill the entire system fresh water and add liquid alkaline compound with emulsifying agents and detergents to remove grease and petroleum products from piping. Circulate solution for a minimum of 24 hours, drain, clean strainer screens, and refill with fresh water. Provide all additional valves, fitting, temporary piping, piping connections and pumps required to isolate sections of pipe intended to be cleaned and flushed from existing or previously cleaned and finished. Refer to Chemical Treat requirements within this specification section for additional requirements.

D. Add initial chemical treatment and maintain water quality in ranges noted above for the first year of operation.

E. Fill all systems as indicated to have antifreeze or glycol solutions with the following concentrations. Exact amount of glycol (new and existing) shall be determined by the contractor based on their metered fill data. Any estimated gallonage of new and/or existing hydronic systems shall be consider an estimate only and exact amounts shall be determined by the contractor prior to bid. Provide owner with metered data at project completion:

1. Hot-Water Heating Piping: Minimum 30 percent propylene glycol.

3.09 FLUSHING AND CLEANING (New Systems)

A. The system must be pressure tested and accepted as leak free per the “Hydronic Piping” specification by the owner prior to flushing and cleaning.

B. Control systems that operate automatic isolation valves, temperature control valves, or other automated hydronic devices must be in place and operational prior to cleaning. Manual operation of automated valves is not acceptable.

C. On completely new piping system installations, the contractor shall use temporary strainers to flush and clean the piping systems. Do not use Owner’s permanent strainers to trap debris during pipe flushing operations. Fit the temporary construction strainers with a line size blowoff valve.

D. The contractor shall submit a cleaning and chemical treatment plan to the owner for approval prior to execution.

E. For new systems that will connect to existing systems utilize section Flushing and Cleaning (Existing / Expanded / Modified systems)

F. The contractor shall:
1. Fill the system with fresh water. Meter the fill level to ascertain the system volume.
2. Open/close automated valves as required to achieve flow in all areas.
    a. The Water Treatment Contractor (WTC) shall work with the design engineer, controls contractor and the Mechanical Contractor (MC) to develop a circulation plan that will ensure flow throughout the facility. In variable volume systems, the pumping system is not designed to operate the entire system at design flow. A coordinated isolation plan is required to circulate the system in sections.
    b. The system should be operated as close to 10 ft/sec as possible during the cleaning and flushing operations.
    c. Install all piping main bypasses as required to facilitate cleaning.
3. Enable the pumps, and circulate the system for a length of time to be determined by the WTC. The circulation cycle time will vary greatly depending on flow, system size and isolation strategy.
4. Flush the system with fresh water for time period as directed by the WTC.
5. Disable the pumps.
6. The WTC will test and verify flush water quality before proceeding.
7. Drain the system.
8. Remove all startup strainers from the system, and clean. This includes strainers at pumps, terminal devices, fill points, etc.
9. Purge the dirt separator (if not connected directly to side stream filter), and replace the side stream filter bag.
10. Fill the system and chemically clean the system as directed by the WTC.
11. Perform additional strainer cleanings in the defined systems as requested by the WTC.
12. Repeat the cleaning process until the WTC deems the system acceptable.
13. Perform final flush as directed by WTC.

14. The WTC will test and verify the final flush water condition before proceeding.
15. Remove all startup strainers from the system, and replace with the specified operational strainer. This includes strainers at pumps, terminal devices, fill points, etc.
16. Refill system to operating pressure, WTC shall treat the system for normal operation.
17. The WTC will provide test reports of system water quality to the owner for verification.

G. The WTC shall:
1. Develop an approved cleaning and treatment plan in coordination with the MC and the BAS contractor.
2. Utilizing labor provided by the MC as needed, flush and chemically clean the defined hydronic systems as required to obtain completely clean and scale free internal piping surfaces.
   a. Criteria for system acceptance:
      1) Acceptable water test results within defined ranges from the main pump location.
      2) Acceptable water test results within defined ranges from remote areas in quantities and locations defined by the WTC.
3. After system cleaning is complete, provide water treatment as needed to allow the loop water quality parameters to fall within the ranges as specified.
4. Maintain hydronic water system testing and treatment throughout the warranty period of (1) year after project acceptance.
5. Provide a project closeout report and ongoing maintenance plan to the owner
   a. Domestic water test results
   b. Initial startup water test results
   c. Monthly water test results during warranty operation
   d. System maintenance schedule
   e. Final water test results, at conclusion of warranty period.
6. At [**four**] week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that chemical treatment program is maintaining water quality within performance requirements specified in this Section. WTC shall schedule the monthly testing with owner representatives. Submit written reports of water analysis advising Owner of changes.

3.010 SLEEVE INSTALLATION

A. General Requirements: Install sleeves for all pipes and tubes passing through penetrations in floors, partitions, roofs, and walls.

B. Sleeves are not required for core-drilled holes.

C. Cut sleeves to length for mounting flush with both surfaces unless otherwise indicated.

D. Install sleeves in new partitions, slabs, and walls as they are built.

E. For interior wall penetrations, seal annular space between sleeve and pipe or pipe insulation using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

F. For exterior wall penetrations above grade, seal annular space between sleeve and pipe using joint sealants appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants" for joint sealants.

G. For exterior wall penetrations below grade, seal annular space between sleeve and pipe using sleeve seals specified in this Section.

H. Seal space outside of sleeves in concrete slabs and walls with grout.

I. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation unless otherwise indicated.

J. Install sleeve materials according to the following applications:

1. Sleeves for Piping Passing through Concrete Floor Slabs: Steel pipe.

2. Sleeves for Piping Passing through Concrete Floor Slabs of Mechanical Equipment Areas or Other Wet Areas: Steel pipe or stack sleeve fittings.

   a. Extend sleeves 2 inches above finished floor level.

   b. For pipes penetrating floors with membrane waterproofing, extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Comply with requirements in Division 07 Section "Sheet Metal Flashing and Trim" for flashing.

3. Sleeves for Piping Passing through Gypsum-Board Partitions:

   a. Galvanized-steel sheet sleeves for pipes NPS 6 and larger.
   b. Exception: Sleeves are not required for water supply tubes and waste pipes for individual plumbing fixtures if escutcheons will cover openings.

4. Sleeves for Piping Passing through Concrete Roof Slabs: Steel pipe.

5. Sleeves for Piping Passing through Exterior Concrete Walls:

   a. Steel pipe sleeves for pipes smaller than NPS 6 (DN 150).

   b. Cast-iron wall pipe sleeves for pipes NPS 6 and larger.

   c. Install sleeves that are large enough to provide 1-inch annular clear space between sleeve and pipe or pipe insulation when sleeve seals are used.

6. Sleeves for Piping Passing through Interior Concrete Walls:

   a. Steel pipe sleeves for pipes smaller than NPS 6.

K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping" for firestop materials and installations.

3.011 SLEEVE SEAL INSTALLATION

A. Install sleeve seals in sleeves in exterior concrete walls at water-service piping entries into building.

B. Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble sleeve seal components and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.012 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.013 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. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

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.

5. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens. Notify the Owner and Engineer one week prior to performing flushing procedures such that procedures can be witnessed.

6. Prepare a written report of flushing procedures indicating the date of flushing and signed by the person performing the procedures validating it has been completed.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is 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 no leaks.

6. Prepare written report of testing indicating the date of testing, the specific procedures and test pressures, and signed by the person performing the work. Submit the report to the Engineer.

7. Provide at the Engineer’s discretion a water quality test by an independent agency to validate flushing procedures have been completed and the chemical treatment has been completed to maintain water quality within the specified ranges.

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 23 21 13

SECTION 23 21 23

HYDRONIC PUMPS

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes the following:

1. Separately coupled, horizontal, in-line centrifugal pumps.
2. Separately coupled, base-mounted, end-suction centrifugal pumps.
3. Automatic condensate pump units.

1.03 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

C. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.

1. Wiring Diagrams: Power, signal, and control wiring.

D. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.

E. Comply with pump manufacturer's written rigging instructions.

1.07 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.08 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Mechanical Seals: One mechanical seal for each pump.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. Inline Pumps

a. Armstrong Pumps Inc.
b. Bell & Gossett; Div. of ITT Industries.
c. Patterson
d. Taco, Inc.
e. Grundfos

2.02 SEPARATELY COUPLED, HORIZONTAL, IN-LINE CENTRIFUGAL PUMPS

A. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, separately coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

B. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and threaded companion-flange connections.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, and keyed to shaft. Trim impeller to match specified performance.

3. Pump Shaft: Stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N bellows and gasket. Include water slinger on shaft between motor and seal.

5. Pump Bearings: Permanently lubricated ball bearings.

C. Shaft Coupling: Molded rubber insert with interlocking spider capable of absorbing vibration.

D. Motor: Single speed, with permanently lubricated ball bearings, unless otherwise indicated; and resiliently mounted to pump casing. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.03 VIBRATION ISOLATION AND SEISMIC CONTROL

A. Provide concrete inertial bases with open spring isolators for all base mounted and end mounted suction pumps.

B. Provide open spring isolator with minimum deflection of 1.5 inch for in-line pumps.

1. Springs: All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. All springs except internal nested springs shall have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs shall be square and ground for stability. Laterally stable springs shall have kx/ky ratios of at least 0.9. All springs shall be fully color-coded to indicate capacity – color striping is not considered adequate.

2. Corrosion Protection: All springs shall be powder-coated enamel. Housings shall be galvanized, powder-coated enamel, or painted with rust-resistant paint. Hot-dipped galvanized housings shall be provided as indicated on the Schedule.

3. Steel Equipment Base: Bases shall be of welded construction with cross members to form an integral support platform. Structural steel members shall be designed to match supported equipment.

4. Vibration bases for fans shall have adjustable motor slide rails as indicated on their Schedule, and shall accommodate motor overhang.

5. Bases for exterior use shall be painted or hot-dipped galvanized for complete corrosion resistance.

6. Minimum clearance under steel equipment bases shall be 1”.

7. Concrete Inertia Base: Inertia bases shall be of welded steel construction with concrete in-fill supplied by the installing contractor on site and shall incorporate reinforcing bars, spaced 12” maximum on centers each way.

8. Inertia bases for pumps shall be of sufficient size to accommodate supports for pipe elbows at pump suction and discharge connections (if this information has been provided for configuration).

9. Inertia bases for fans shall include motor slide rails as indicated on their Schedule.

10. The weight of each inertia base shall be sufficient to lower the center of gravity to or below the isolator support plane.

11. Inertia bases shall be a minimum of 6” thick.

12. Spring Hangers: Vibration isolator hanger supports with steel springs and welded steel housings. The hanger bracket shall be designed to carry a 500% overload without failure and to allow a support rod misalignment through a 30-degree arc without metal-to-metal contact or other short circuit. Hangers serving lightweight loads 200 lbs and less may be exempt from this requirement.

2.04 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, 175-psig pressure rating, cast-iron body and end cap, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and factory-fabricated support.

B. Grooved-End Suction Diffuser – Flanged outlet with grooved inlet connections, rated to 300 psi (2065 kPa). Ductile iron (ASTM A-536) body, 304 stainless steel frame and perforated sheet diffuser with 5/32" (4,0mm) diameter holes. Removable 20 mesh 304 stainless steel start-up pre-filter, outlets for pressure/temperature drain connections, and base support boss. Equal to Victaulic Series 731-G and W731-G.

C. Triple-Duty Valve: Angle or straight pattern, 175-psig pressure rating, cast-iron body, pump-discharge fitting; with drain plug and bronze-fitted shutoff, balancing, and check valve features. Brass gage ports with integral check valve, and orifice for flow measurement.

D. Tri-Service Valve Assembly: Combination shut-off, throttling and non-slam check valve.

1. 2-1/2” through 12”: Equal to Vic-300 MasterSeal butterfly valve with memory stop feature assembled with Series 716 (2-1/2” & 3”) or Style 779 Venturi Check (4” – 12”). Series 779 check valve with venturi like taps for flow measurement. Working pressures to 300 psi (2065 kPa).

2.05 INTERIAL BASE FRAME

A. Rectangular structural beam channel, or complete sheet metal box concrete forms for floating foundations, with materials complying with ASTM A36, minimum depth of 0.08 x longest dimension of base, but not less than 6” deep.

1. Provide steel reinforcing both ways with both ends of reinforcing butt welded to base framing.

2. Provide welded support brackets at points indicated, and anchor base frame to spring isolator units.

3. Provide anchor bolts, located as required for equipment anchorage and supported for casting of concrete. Locate bolts as indicated.

4. Provide adjustable bolts in pipe sleeves; for minimum of ½” adjustment around anchor bolts.

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CONCRETE BASES

A. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.03 PUMP INSTALLATION

A. Comply with manufacturer’s written instructions and guidelines.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Set base-mounted pumps on concrete foundation. Disconnect coupling before setting. Do not reconnect couplings until alignment procedure is complete.

1. Support pump baseplate on rectangular metal blocks and shims, or on metal wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

E. Automatic Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.04 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation."

D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

E. Grout pump mounting base full after piping is connected but before pump drive is aligned. After grouting, align pump drive shaft to 5 mils, even if pump is factory aligned, and conduct vibration test.

3.05 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 machine to allow service and maintenance.

C. Connect piping to pumps. Install valves that are same size as piping connected to pumps.

D. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

E. Install check valve and throttling valve on discharge side of pumps.

F. Install suction diffuser and shutoff valve on suction side of pumps.

G. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

H. Install pressure gages on pump suction and discharge, at integral pressure-gage tapping, or install single gage with multiple input selector valve.

I. Install check valve and gate or ball valve on each condensate pump unit discharge.

3.06 STARTUP SERVICE

A. Complete pump start-up procedures in accordance with the manufacturer's instructions and guidelines. At a minimum perform the following:

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.

3.07 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 "Demonstration and Training."

END OF SECTION 23 21 23

SECTION 23 23 00

REFRIGERANT PIPING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-407C:

1. Suction Lines for Air-Conditioning Applications: 230 psig.
2. Suction Lines for Heat-Pump Applications: 380 psig.
3. Hot-Gas and Liquid Lines: 380 psig.

B. Line Test Pressure for Refrigerant R-410A:

1. Suction Lines for Air-Conditioning Applications: 300 psig.
2. Suction Lines for Heat-Pump Applications: 535 psig.
3. Hot-Gas and Liquid Lines: 535 psig.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:

1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

C. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: 1/4 inch equals 1 foot.

2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum,

equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.06 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.07 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2: PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR, ASTM B88, Type L or K.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:

1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
2. End Connections: Socket ends.
3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
4. Pressure Rating: Factory test at minimum 500 psig.
5. Maximum Operating Temperature: 250 deg F.

2.02 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:

1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.

2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
3. Operator: Rising stem and hand wheel.
4. Seat: Nylon.
5. End Connections: Socket, union, or flanged.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:

1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:

1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
3. Piston: Removable polytetrafluoroethylene seat.
4. Closing Spring: Stainless steel.
5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
8. Working Pressure Rating: 500 psig.
9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:

1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 500 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.

1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and [**24**] [**115**] [**208**]-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.

1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 400 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.

1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Straight-Type Strainers:

1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Moisture/Liquid Indicators:

1. Body: Forged brass.
2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
5. End Connections: Socket or flare.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 240 deg F.

J. Replaceable-Core Filter Dryers: Comply with ARI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
3. Desiccant Media: Activated alumina.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
6. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
7. Working Pressure Rating: 500 psig.
8. Maximum Operating Temperature: 240 deg F.

K. Receivers: Comply with ARI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
3. Body: Welded steel with corrosion-resistant coating.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
6. Working Pressure Rating: 500 psig.
7. Maximum Operating Temperature: 275 deg F.

L. Liquid Accumulators: Comply with ARI 495.

1. Body: Welded steel with corrosion-resistant coating.
2. End Connections: Socket or threaded.
3. Working Pressure Rating: 500 psig.

4. Maximum Operating Temperature: 275 deg F.

2.03 REFRIGERANTS

A. ASHRAE 34, R-22: Monochlorodifluoromethane.

B. ASHRAE 34, R-134a: Tetrafluoroethane.

C. ASHRAE 34, R-407C: Difluoromethane/Pentafluoroethane/1,1,1,2-Tetrafluoroethane.

D. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3: EXECUTION

3.01 PIPING APPLICATIONS

A. Suction Lines NPS 1-1/2 and smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing or Type L drawn temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 2 to NPS 4 for Conventional Air-Conditioning Applications: Copper, Type L, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines:

1. NPS 1-1/2: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

2. NPS 2 to NPS 4: Copper, Type L, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

D. Safety-Relief-Valve Discharge Piping: Copper, Type K, drawn-temper tubing and wrought-copper fittings with soldered joints.

3.02 VALVE AND SPECIALTY APPLICATIONS

A. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

B. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

C. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

D. Install a full-sized, three-valve bypass around filter dryers.

E. Install thermostatic expansion valves as close as possible to distributors on evaporators.

1. Install valve so diaphragm case is warmer than bulb.

2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.

3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

F. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

G. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

H. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:

1. Solenoid valves.
2. Thermostatic expansion valves.
3. Hot-gas bypass valves.
4. Compressor.

I. Install filter dryers in liquid line between compressor and thermostatic expansion valve.

J. Install receivers sized to accommodate pump-down charge where recommended by the equipment manufacturer.

K. Install flexible connectors at compressors.

3.03 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.

2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

P. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.04 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

F. Threaded Joints: Thread steel 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.

G. Steel pipe can be threaded, but threaded joints must be seal brazed or seal welded.

H. Welded Joints: Construct joints according to AWS D10.12/D10.12M.

I. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.05 HANGERS AND SUPPORTS

A. Comply with requirements in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment" for pipe hanger and support products and installation.

1. Vertical Piping: MSS Type 8 or 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: MSS Type 1, adjustable, steel clevis hangers.

3. Multiple, Straight, Horizontal Piping Runs: Field fabricated, heavy duty trapeze. Fabricate from steel shapes and rod diameters as required for loads per MSS SP-58 and MSS SP-69. Verify rod diameter with structural engineer for multiple pipe trapeze hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install supports for vertical copper tubing every 10 feet.

E. Install supports for vertical steel piping every 15 feet.

F. Install hangers for horizontal piping with the following minimum rod sizes and maximum spacing for trapeze type hangers with multiple rise runs of varying sizes. The hangers shall be spaced based upon the smallest diameter pipe.

Nom. Pipe Size – Inches	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - Inches
Up to ¾	7	5	3/8
1	7	6	3/8
1-1/4	7	7	3/8
1-1/2	9	8	3/8
2	10	8	3/8
2-1/2	11	9	½

G. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions and prior approved spacing by the structural engineer.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.

2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.

3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.

   a. Fill system with nitrogen to the required test pressure.

   b. System shall maintain test pressure at the manifold gage throughout duration of test.

   c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.

   d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.07 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.

2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.

3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.

4. Charge system with a new filter-dryer core in charging line.

3.08 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 23 23 00

SECTION 23 31 13

DUCTWORK

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Double-wall rectangular ducts and fittings.
3. Single-wall round ducts and fittings.
4. Sheet metal materials.
5. Duct liner.
6. Sealants and gaskets.
7. Hangers and supports.

B. Related Sections:

1. Section 01 45 43 “Testing, Adjusting and Balancing” for testing, adjusting, and balancing requirements for metal ducts.

2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.04 PERFORMANCE REQUIREMENTS

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated.

1. Static-Pressure Classes:

a. Supply Ducts (non-variable air volume systems): 3-inch.
b. Supply Ducts (Upstream from Air Terminal Units): 4 inch.
c. Supply Ducts (Downstream from Air Terminal Units): 1 inch.
d. Return Ducts (Negative Pressure): 2-inch wg.
e. Exhaust Ducts (Negative Pressure): 2-inch wg.
f. Fume Hoods (Negative Pressure): 2 inch.
g. Vehicle/Welding Exhaust (Negative Pressure): 6 inch.

1.05 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

C. Shop Drawings

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. Coordination Drawings: Refer to requirements in Section 23 05 00 “Common Work Results for HVAC.”

E. Welding certificates.

F. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. Leakage Tests: Perform tests as directed by the Testing Agent and submit reports.

PART 2: PRODUCTS

2.01 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A.

1. Transverse Joints in Ducts Larger Than 24 Inches in length or width: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A. All rectangular ductwork elbows shall be fabricated with turning vanes.

2.02 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A

1. Transverse Joints in Ducts Larger Than 24 Inches in Diameter: Flanged.

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A

1. Fabricate round ducts larger than 30 inches in diameter with butt-welded longitudinal seams.

2. Fabricate flat-oval ducts larger than 40 inches in width (major dimension) with butt-welded longitudinal seams.

D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." and IECC-2012 Class A

2.03 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

D. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.04 DUCTWORK FABRICATION SCHEDULES:

A. All ductwork shall be constructed of at a minimum gauge as followings. All sheetmetal, unless specified otherwise, shall be the best grade, of gauge indicated below and complying with SMACNA HVAC Duct Construction Standards and applicable codes.

Rectangular Duct Width	Round Duct Width	Low Pressure Gauge	Medium Pressure Gauge
4” thru 30”	3” thru 26”	24	22
31” thru 54”	27” thru 36”	22	20
55” thru 84”	37” thru 50”	20	18
85” and above	51” thru 72”	18	16

B. All panels over 12-inches wide or deep shall be cross-broken for strength.

C. The Architect/Engineer reserves the right to require additional bracing at no additional cost to the Owner, if deemed necessary.

2.05 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Maximum Thermal Conductivity:

   a. Type I, Flexible: 0.27 Btu x in./h x sq. ft. 75 deg F mean temperature.
   b. Type II, Rigid: 0.23 Btu x in./h x sq. ft. 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ATSM E 84 and ASTM C 534 guidlines, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
2. Closed cell foam, 0.27 BTU/in/Sq.ft at 75 deg F mean temperature.
3. 1” thickness, 3 lb density.
4. Shall meet minimum sound absorption coefficency rating of .48 at 500 Hertz frequency.
5. Shall not support microbial growth.
6. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   a. Provide at all transfer ducts shown on the drawings.
   b. Provide at all supply and return ductwork a minimum distance of 15 feet from the air handling and/or roof top unit unless addition length is shown on drawings. Supply and Return ductwork shall also be provided with external insulation per specification.
   c. Provide at all exhaust ductwork a minimum distance of 10 feet from the exhaust fan unless addition length is shown on drawings.

C. Natural-Fiber Duct Liner: 85 percent cotton, 10 percent borate, and 5 percent polybinding fibers, treated with a microbial growth inhibitor and complying with NFPA 90A or NFPA 90B.

1. Maximum Thermal Conductivity: 0.24 Btu x in./h x sq. ft. 75 deg F mean temperature when tested according to ASTM C 518.

2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to ASTM E 84; certified by an NRTL.

3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

E. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.

2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.

3. Butt transverse joints without gaps, and coat joint with adhesive.

4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.

6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.

7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

   a. Fan discharges.
   b. Intervals of lined duct preceding unlined duct.
   c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.

8. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.06 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 4 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.

2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.07 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

PART 3: EXECUTION

3.01 DUCT APPLICATIONS

A. Fabricate ducts with galvanized sheet steel except as follows:

1. Exposed Ductwork
   a. Hot dipped galvanized steel “paint-grip” and shall be painted with a high quality paint equal to Sherwin Williams Waterborne Acrylic Dryfall B42W series compatible for painting of exposed ductwork.

B. Intermediate Reinforcement:

1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts: Galvanized steel.
3. Aluminum Ducts: Aluminum or galvanized sheet steel coated with zinc chromate.

C. Liner (all transfer air ducts and as noted on the plans):

1. Supply- and Return-Air Ducts: Closed Cell Foam, Type I, 1 inch thick unless otherwise noted on the plans.
   a. Provide liner in all supply and return air ducts a minimum distance of 15 feet from all air handling / rooftop units.
2. Transfer Ducts: Closed Cell Foam, Type I, 1 inch thick.

D. Elbow Configuration:

1. Rectangular Duct: At a minimum Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."

   a. Velocity 1000 fpm or Lower

      1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio.
      2) Mitered Type RE 4 without vanes.

   b. Velocity 1000 to 1500 fpm:

      1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio.
      2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.
      3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

   c. Velocity 1500 fpm or Higher:

      1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.

2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."

a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.

1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.

b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.

c. Round Elbows, 14 Inches and Larger in Diameter: Welded.

E. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."

a. Rectangular Main to Rectangular Branch: 45-degree entry.
b. Rectangular Main to Round Branch: Spin in.

2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.

a. Velocity 1000 fpm or Lower: 90-degree tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

3.02 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's “Duct Cleanliness for New Construction Guidelines.”

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and joints for duct static-pressure and leakage classes specified in "Performance Requirements" Article, according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements," and IECC-2012 Class A.

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," and IECC-2012 Seal Class A:

B. Seal Classes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 1-2, "Standard Duct Sealing Requirements." and IECC-2012 Class A

1. For static-pressure classes 1- and 1/2-inch wg, comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," and IECC-2012 Class A:

3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.

2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.

4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.07 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." and most current IECC code

2. Test the following systems:

   a. Supply air.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

4. Test for leaks before insulation application.

5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.

C. Duct system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 23 31 13

SECTION 23 33 00

AIR DUCT ACCESSORIES

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 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Barometric relief dampers.
3. Manual volume dampers.
4. Control dampers.
5. Flange connectors.
6. Turning vanes.
7. Remote damper operators.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.

B. Related Sections:

1. Division 23 Section "Air Handling" for roof-mounted ventilator caps.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of product indicated.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

C. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.

b. Manual volume damper installations.

c. Control damper installations.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

E. Source quality-control reports.

F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

PART 2: PRODUCTS

2.01 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.

2. Exposed-Surface Finish: Mill phosphatized.

C. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.

D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Description: Gravity balanced.

B. Maximum Air Velocity: 2000 fpm.

C. Maximum System Pressure: 2-inch wg.

D. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

E. Blades: Multiple single-piece blades, maximum 6-inch width, 0.050-inch- thick aluminum sheet with sealed edges.

F. Blade Action: Parallel.

G. Blade Seals: Extruded vinyl, mechanically locked or Neoprene, mechanically locked.

H. Blade Axles:

1. Material: Aluminum.

2. Diameter: 0.20 inch.

I. Tie Bars and Brackets: Aluminum.

J. Return Spring: Adjustable tension.

K. Bearings: Steel ball or synthetic pivot bushings.

L. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
2. Counterweights and spring-assist kits for vertical airflow installations.
3. Electric actuators.
4. Chain pulls.
5. Front of rear screens.
6. 90-degree stops.

M. Sleeve: Minimum 20-gage thickness.

2.03 BAROMETRIC RELIEF DAMPERS

A. Suitable for horizontal or vertical mounting.

B. Maximum Air Velocity: 2000 fpm.

C. Maximum System Pressure: 2-inch wg.

D. Frame: 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

E. Blades:

1. Multiple, 0.050-inch- thick aluminum sheet.
2. Maximum Width: 6 inches.
3. Action: Parallel.
4. Balance: Gravity.
5. Eccentrically pivoted.

F. Blade Seals: Vinyl or Neoprene.

G. Blade Axles: Nonferrous metal.

H. Tie Bars and Brackets:

1. Material: Aluminum.
2. Rattle free with 90-degree stop.

I. Return Spring: Adjustable tension.

J. Bearings: Synthetic or Stainless steel.

K. Accessories:

1. Flange on intake.
2. Adjustment device to permit setting for varying differential static pressures.

2.04 MANUAL VOLUME DAMPERS

A. Provide manual volume balancing dampers at all branch ductwork on the supply, return and exhaust systems where the duct branches are taken from another duct whether specifically shown on the plans or not and as required for balancing. Install minimum 2 duct widths from duct take-off.

B. Provide manual volume balancing dampers at each branch duct serving a diffuser, register or grille, regardless of whether dampers are specified as part of the diffuser, grille or register assembly. Provide whether specifically shown on the plans or not.

C. Standard, Steel, Manual Volume Dampers:

1. Standard leakage rating 20 cfm/sqft.

2. Suitable for horizontal or vertical applications.

3. Frames:

   a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
   b. Mitered and welded corners.
   c. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Stiffen damper blades for stability.
   d. Galvanized-steel, 0.064 inch thick.

5. Blade Axles: Galvanized steel.

6. Bearings:

   a. Oil-impregnated bronze or Molded synthetic.
   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Galvanized steel.

D. Standard, Aluminum, Manual Volume Dampers:

1. Standard leakage rating.

2. Suitable for horizontal or vertical applications.

3. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.

c. Stiffen damper blades for stability.
d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.

5. Blade Axles: Stainless steel or Nonferrous metal.

6. Bearings:

a. Oil-impregnated bronze or Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Tie Bars and Brackets: Aluminum.

E. Low-Leakage, Steel, Manual Volume Dampers:

1. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage 20 cfm/ft.

2. Suitable for horizontal or vertical applications.

3. Frames:

a. Hat, U or Angle shaped.
b. Galvanized-steel channels, 0.064 inch thick.
c. Mitered and welded corners.
d. Flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

a. Multiple or single blade.
b. Parallel- or opposed-blade design.
c. Stiffen damper blades for stability.
d. Galvanized, roll-formed steel, 0.064 inch thick.

5. Blade Axles: Galvanized steel.

6. Bearings:

a. Oil-impregnated bronze or Molded synthetic.
b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Blade Seals: Vinyl or Neoprene.

8. Jamb Seals: Cambered aluminum.

9. Tie Bars and Brackets: Galvanized steel.

10. Accessories:

a. Include locking device to hold single-blade dampers in a fixed position without vibration.

F. Low-Leakage, Aluminum, Manual Volume Dampers:

1. Low-leakage rating and bearing AMCA's Certified Ratings Seal for both air performance and air leakage 20 cfm/ft.

2. Suitable for horizontal or vertical applications.

3. Frames: Hat, U or Angle-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.

4. Blades:

   a. Multiple or single blade.
   b. Parallel- or opposed-blade design.
   c. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.

5. Blade Axles: Galvanized steel.

6. Bearings:

   a. Oil-impregnated bronze or Molded synthetic.

   b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

7. Blade Seals: Vinyl or Neoprene.

8. Jamb Seals: Cambered aluminum.

9. Tie Bars and Brackets: Aluminum.

10. Accessories:

    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

G. Jackshaft:

1. Size: 1-inch diameter.

2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.

2. Include center hole to suit damper operating-rod size.

3. Include elevated platform for insulated duct mounting.

2.05 CONTROL DAMPERS

A. Provide motorized dampers unless otherwise specified to be provided in Section 23 09 00 “Building Automation System.”

B. Low-leakage rating, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage 4 cfm/ft.

C. Frames:

1. Hat, U or Angle shaped.
2. Galvanized-steel channels, 0.064 inch thick.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 8 inches.
2. Parallel- and opposed-blade design.
3. Galvanized steel.
4. 0.064 inch thick.
5. Blade Edging: Closed-cell neoprene edging.

E. Blade Axles: 1/2-inch- diameter; galvanized steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze or Molded synthetic.

2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

3. Thrust bearings at each end of every blade.

2.06 TURNING VANES

A. Turning vanes shall be installed in all rectangular elbows whether or not specifically shown on the drawings.

B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.07 DUCT-MOUNTED ACCESS DOORS

A. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Number of Hinges and Locks:

   a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.

   b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.

   c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches.

   d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.08 DUCT ACCESS PANEL ASSEMBLIES

A. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

B. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

C. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

D. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.09 FLEXIBLE CONNECTORS

A. Materials: Flame-retardant or noncombustible fabrics.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to 2 strips of 2-3/4-inch-wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

   1. Minimum Weight: 26 oz./sq. yd..
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

E. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

   1. Minimum Weight: 24 oz./sq. yd..
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.

   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.010 FLEXIBLE DUCTS

A. Insulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire; fibrous-glass insulation; reinforced aluminized, polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 2-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 20 to plus 250 deg F.
4. Minimum R-Value: R-6
5. Flame spread < 25, Smoke developed < 50.

B. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.011 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. All duct accessories located in wash bay, wash bay equipment rooms or chemical storage rooms stall be all aluminum construction.

C. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

D. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.

F. Provide manual volume balancing dampers at all branch ductwork on the supply, return and exhaust systems where the duct branches are taken from another duct whether specifically shown on the plans or not and as required for balancing. Install minimum 2 duct widths from duct take-off.

G. Provide manual volume balancing dampers at each branch duct serving a diffuser, register or grille, regardless of whether dampers are specified as part of the diffuser, grille or register assembly. Provide whether specifically shown on the plans or not.

1. Coordinate subparagraphs below with Division 23 Section "Metal Ducts."Install steel volume dampers in steel ducts.

2. Install aluminum volume dampers in aluminum ducts.

H. Set dampers to fully open position before testing, adjusting, and balancing.

I. Install test holes at fan inlets and outlets and elsewhere as indicated.

J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On both sides of duct coils.

2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.

3. At each change in direction and at maximum 50-foot spacing.

4. Upstream of turning vanes.

5. Elsewhere as indicated.

K. Install access doors with swing against duct static pressure.

L. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

N. Install flexible connectors to connect ducts to equipment.

O. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

P. Connect supply diffusers and supply grilles to ducts directly with maximum 60-inch lengths of flexible duct clamped or strapped in place. Contractor to provide and field fabricate diffuser and/ grille plenum for duct connection as required.

Q. Connect return and exhaust grilles/registers to ducts directly with maximum 30-inch lengths of flexible duct clamped or strapped in place.

R. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

S. Install duct test holes where required for testing and balancing purposes.

T. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.02 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.

3. Inspect turning vanes for proper and secure installation.

END OF SECTION 23 33 00

SECTION 23 34 16

AIR HANDLING

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes the following:

1. In-line centrifugal fans.
2. Propeller fans.

1.03 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

C. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

D. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.

2. Ceiling suspension assembly members.

3. Size and location of initial access modules for acoustical tile.

4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.05 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2: PRODUCTS

2.01 IN-LINE CENTRIFUGAL FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Greenheck.

3. Loren Cook Company.
4. Penn Ventilation.
5. Twin City Fan

B. Description: In-line, direct or belt-driven centrifugal fans as indicated on the drawings, consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.

C. Housing: Split, spun aluminum with aluminum straightening vanes, inlet and outlet flanges, and support bracket adaptable to floor, side wall, or ceiling mounting.

D. Direct-Driven Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Belt-Driven Units: Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.

F. Fan Wheels: Aluminum, airfoil blades welded to aluminum hub.

G. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent. Provide on all direct drive fans and as noted on the drawings.

2. Volume-Control Damper: Manually operated with quadrant lock, located in fan outlet.

3. Companion Flanges: For inlet and outlet duct connections.

4. Fan Guards: 1/2- by 1-inch mesh of galvanized steel in removable frame. Provide guard for inlet or outlet for units not connected to ductwork.

5. Motor and Drive Cover (Belt Guard): Epoxy-coated steel.

6. Vibration Isolators: Elastomeric hangers.

2.02 PROPELLER FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Acme Engineering & Mfg. Corp.
2. Aerovent; a Twin City Fan Company.
3. Barry Blower Div.; Penn Ventilation Companies, Inc.
4. Greenheck.
5. Loren Cook Company.
6. Twin City Fan

B. Description: Fan wheel and housing, factory-mounted motor with belt drive or direct drive and accessories.

C. Housings: Housing shall be minimum 3/16” steel with continuously welded seam. Housing shall incorporate minimum 2” x 2” x 1/4” continuously welded inlet and outlet flanges pre-punched for mounting.

1. Inlet and Outlet Connections: Flanges.

D. Wheel Assemblies: Steel with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

E. Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.2

2. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

3. Fan Pulleys: Cast iron with split, tapered bushing; dynamically balanced at factory.

4. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

5. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

6. Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

7. Motor Mount: Adjustable base.

8. Shaft Bearings: Radial, self-aligning ball or roller bearings.

    a. Ball-Bearing Rating Life: Construction shall be heavy duty regreasable ball or roller type in a cast iron pillowblock housing selected for a minimum L50 life in excess of 500,000 hours for horizontal units, and L50 life in excess of 250,000 hours for vertical units at maximum cataloged operating speed

    b. Extend lubrication lines to outside of casing and terminate with grease fittings.

F. Accessories:

1. Companion Flanges: Rolled flanges of same material as housing.

2. Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.

3. Propeller Access Section Door: Short duct section bolted to fan inlet and outlet allowing access to internal parts of fan for inspection and cleaning, of same material as housing.

4. Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.

5. Mounting Clips: Mounting clips welded to fan housing, of same material as housing.

6. Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.

7. Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.

8. Inlet and Outlet Screens: Wire-mesh screen on fans not connected to ductwork of same material as housing.

9. Backdraft Dampers: Butterfly style, for mounting with flexible connection to the discharge of fan or direct mounted to the discharge diffuser section of same material as housing.

10. Flow Measurement Port: Pressure measurement taps installed in the inlet of fan to detect and signal airflow readings to temperature-control systems. Control devices and sequence of operation are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls."

11. Shaft Seal: Elastomeric seal and Teflon wear plate, suitable for up to300 deg F.

12. Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.

13. Vibration Isolators: Spring isolators having 1-inch static deflection.

G. Factory Finishes:

1. Sheet Metal Parts: Prime coat before final assembly.

2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.03 MOTORS

A. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

B. Enclosure Type: Totally enclosed, fan cooled.

2.04 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3: EXECUTION

3.01 INSTALLATION

A. Install power ventilators level and plumb.

B. Support units using elastomeric mounts, restrained elastomeric mounts, spring isolators or restrained spring isolators having a static deflection of 1 inch.

C. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

D. Support suspended units from structure using threaded steel rods and elastomeric hangers or spring hangers as specified having a static deflection of 1 inch.

E. Install units with clearances for service and maintenance.

F. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.

6. Adjust damper linkages for proper damper operation.

7. Verify lubrication for bearings and other moving parts.

8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.

10. Shut unit down and reconnect automatic temperature-control operators.

11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 1 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

3.05 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 34 16

SECTION 23 37 13

DIFFUSERS, REGISTERS, AND GRILLES

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. Related Sections:

1. Division 08 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.

2. Division 23 Section "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.03 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.

2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Anemostat
2. Titus
3. Price
4. Tuttle & Bailey
5. Raymon Donco
6. Performance Air Products

2.02 CEILING AIR DIFFUSERS

A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.

D. Types: Provide ceiling diffusers of type, capacity, and with accessories and finishes as listed on diffuser schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Diffuser Faces:

   a. Round: Round housing, core of concentric rings, round duct connection.
   b. Square: Square housing, core of square concentric louvers, square or round duct connection.
   c. Linear: Extruded aluminum continuous slot, single or multiple.

2. Diffuser Mountings:

   a. Lay-in: Diffuser housing sized to fit between ceiling exposed suspension tee bars and rest on top surface of tee bar.

   b. Duct-mounted.

3. Diffuser Patterns:

   a. Fixed: Fixed position core with concentric rings or louvers for radial air flow around entire perimeter of diffuser.

   b. Adjustable: Manual adjustable core with concentric rings or louvers, fully adjustable for horizontal to vertical air flow.

4. Diffuser Dampers:

   a. Provide only on diffusers located in an inaccessible ceiling system and/or where a branch duct manual balancing damper can not be installed.
      1) Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of diffuser.
      2) Integral: Combination volume control and pattern adjustment for linear diffusers.

5. Diffuser Accessories:

   a. Equalizing Deflectors: Adjustable parallel blades in frame for straightening air flow.

   b. Blank-Off Baffles: Arc segments designed to fit into diffuser housing to divert air flow from impinging on obstruction, and to create directional pattern.

   c. Operating Keys: Tools designed to fit through diffuser face and operate volume control device and/or pattern adjustment.

6. Diffuser Finishes:

   a. White Enamel: Semi-gloss white enamel prime finish.

2.03 WALL REGISTERS AND GRILLES

A. General: Except as otherwise indicated, provide manufacturer's standard wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.

B. Performance: Provide wall registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.

C. Wall Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall systems, and that are specifically manufactured to fit into wall construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall construction which will contain each type of wall register and grille.

D. Types: Provide wall registers and grilles of type, capacity, and with accessories and finishes as listed on register and grille schedule. The following requirements shall apply to nomenclature indicated on schedule:

1. Register and Grille Materials:

   a. Steel Construction (ST): Manufacturer's standard stamped sheet steel frame and adjustable blades.

   b. Aluminum Construction (AL): Manufacturer's standard extruded aluminum frame and adjustable blades.

2. Register and Grille Faces:

   a. Horizontal Straight Blades: Horizontal blades, individually adjustable, at manufacturer's standard spacing.

   b. Vertical Straight Blades: Vertical blades, individually adjustable, at manufacturer's standard spacing.

   c. Horizontal 45^{o} Fixed Blades: Horizontal blades, fixed at 45^{o}, at manufacturer's standard spacing.

3. Register and Grille Patterns:

   a. Single Deflection: 1 set of blades in face.

   b. Double Deflection: 2 sets of blades in face, rear set at 90^{o} to face set.

4. Register and Grille Dampers:

   a. Opposed Blade: Adjustable opposed blade damper assembly, key operated from face of register.

5. Register and Grille Accessories:

   a. Operating Keys: Tools designed to fit through register or grille face and operate volume control device and/or pattern adjustment.

6. Register and Grille Finishes:

   a. White Enamel: Semi-gloss white enamel prime finish.

2.04 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, “Method of Testing for Rating the Performance of Air Outlets and Inlets.”

PART 3: EXECUTION

3.01 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.03 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 23 37 13

SECTION 23 52 16

CONDENSING BOILERS

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, fire-tube, water-tube, water-jacketed condensing boilers, trim, and accessories for generating hot water.

1.03 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

C. Efficiency Curves: At a minimum, submit efficiency curves for high and low input firing rates at incoming water temperatures ranging from 80°F to 160°F.

D. Pressure Drop Curves: Submit pressure drop curve for entire range of boiler.

E. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: Power, signal, and control wiring.

F. Operation and Maintenance Data: For boilers to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

C. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."

E. DOE Compliance: Minimum efficiency shall comply with 10 CFR 430, Subpart B, Appendix N, “Uniform Test Method of Measuring the Energy Consumption of Furnaces and Boilers.”

F. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a testing agency acceptable to authorities having jurisdiction.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail due to condensate corrosion, thermal stress, materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers (GAS FIRED):
    a. Pressure Vessel and Heat Exchanger: 10 NON Prorated years from date of Shipment.
    b. Control Panels: 2 years from date of Shipment.
    c. Other Components with the exception of the igniter and flame detector: 18 months from date of shipment.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Fire Tube Condensing Boilers (GAS FIRED)
    a. Lochinvar
    b. Laars
    c. RBI

B. It shall be the responsibility of the Contractor to insure that any substituted equipment is equivalent in fit, form and function to the specified equipment. The cost of any additional work caused by the substitution of equipment shall be borne by the Contractor.

2.02 MANUFACTURED UNITS – FIRE TUBE CONDENSING BOILER (GAS FIRED)

A. Description: Factory-fabricated, -assembled, and -tested, fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; flue-gas vent & combustion-air intake connections; water supply, return, and condensate drain connections; and controls.

B. Heat Exchanger: Constructed entirely of 439 or 316 stainless steel.

C. Pressure Vessel: Carbon steel with welded heads.

D. Burner: Natural gas, forced draft.

E. Blower: Variable Speed Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with requirements specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

    a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

F. Modulating Air/Fuel Valve and Burner: The boiler burner shall be capable of a minimum 10 to 1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 20 ppm of NOx corrected to 3% excess oxygen.

G. Oxygen Monitoring: Boiler shall have an O2 monitoring system that will measure the oxygen content of the exhaust gases in real time which can be displayed on the control panel.

H. Gas Train: Gas valve(s) with manual shutoff and pressure regulator as per CSD-1.

I. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

J. Provide all condensing boilers with an approved condensate neutralization kit.

K. Casing:

1. Jacket: Sheet metal, with snap-in or interlocking closures.
2. Control Compartment Enclosures Unit Mounted.
3. Finish: Baked-enamel protective finish.
4. Combustion-Air Connections: Inlet and vent duct collars.

L. Characteristics and Capacities:

1. Heating Medium: Hot water.
2. Design Water Pressure Rating: 160 psig.
3. Safety Relief Valve Setting: 60 psig**.**
4. No Min return water temperature
5. Minimum AHRI Combustion Efficiency: 93%

2.03 TRIM

A. Aquastat Controllers: Operating and high limit.

B. Safety Relief Valve: ASME rated.

C. Pressure and Temperature Gage: Minimum 3-1/2-inch- diameter, combination water-pressure and -temperature gage. Gages shall have operating-pressure and -temperature ranges so normal operating range is about 50 percent of full range.

D. Boiler Air Vent: Automatic.

E. Drain Valve: Minimum NPS 3/4 hose-end gate valve.

2.04 CONTROLS

A. Refer to Division 23 Section "Building Automation System."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.

2. Operating Temperature Controller: Set points shall be adjustable.

3. Sequencing Controller: Multiple boiler systems shall have a lead/lag sequencing controller either integral to the boilers or as a separate panel.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Temperature Cutoff: Units shall have one automatic and one manual reset to stop burner if operating conditions rise above maximum boiler design temperature.

2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be manual-reset type.

3. Blocked Inlet Safety Switch: Manual-reset pressure switch field mounted on boiler combustion-air inlet.

4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:

a. Monitoring: On/off status, common trouble alarm
b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building management system. Communication protocol to be: Modbus, BacNet, N2

2.05 ELECTRICAL POWER

A. Single-Point Field Power Connection: Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.

1. Wiring shall be numbered and color-coded to match wiring diagram.
2. Install factory wiring outside of an enclosure in a metal raceway.
3. Field power interface shall be to a fused disconnect switch supplied by electrical contractor.

2.06 VENTING KITS

A. Exhaust Vent Kit: Complete system as per plans including but not limited to: pipe, vent terminal, thimble, indoor plate, vent adapter, and sealant. See Section Breeching Chimney & Stacks and follow manufacturer's recommendations. Exhaust Vent to be AL29-4C

B. Combustion-Air Intake: Complete system as per plans including but not limited to: pipe, vent terminal with screen, inlet air coupling, and sealant. Follow manufacturer's recommendations. Intake pipe shall be insulated PVC.

2.7 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.

PART 3: EXECUTION

3.01 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.03 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 boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 23 Section "Common Work Results for HVAC."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Provide emergency boiler shut-off switch at the door for each room with boilers installed. Interlock boiler to emergency shut-off switch. Verify exact location of emergency shut-off switch with local authority

H. Install piping from safety relief valves to nearest floor drain.

I. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

J. Boiler Venting:

1. Install flue venting kit and combustion-air intake.

2. Connect full size to boiler connections. Comply with requirements in Division 23 Section "Breechings, Chimneys, and Stacks."

3.04 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. Perform installation and startup checks according to manufacturer's written instructions.

2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.

3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.

b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Performance Tests:

1. Engage a factory-authorized service representative to inspect component assemblies and equipment installations, including connections, and to conduct performance testing.

2. Boilers shall comply with performance requirements indicated, as determined by field performance tests. Adjust, modify, or replace equipment to comply.

3. Operating Adjustments: When requested or within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied operating conditions. Provide up to three visits to Project during other than normal occupancy hours during the heating season for this purpose.

4. Perform field performance tests to determine capacity and efficiency of boilers.

a. Test for full capacity.

b. Test for boiler efficiency at low fire 40, 60, 80, and 100 percent of full capacity. Determine efficiency at each test point.

5. Repeat tests until results comply with requirements indicated.

6. Provide analysis equipment required to determine performance.

7. Provide temporary equipment and system modifications necessary to dissipate the heat produced during tests if building systems are not adequate.

8. Notify Architect and Engineer in advance of test dates.

9. Document test results in a report and submit to Architect and Engineer.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 52 16

SECTION 23 54 00

FURNACES

PART 1: GENERAL

1.01 SUMMARY

A. This Section includes all labor, materials, equipment, skills and tools necessary to provide gas fired heating units as scheduled on the drawings and specified herein. Types of gas fired heating units specified in this Section include:

1. Gas Fired Light Commercial Grade Furnaces.

1.02 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.04 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Submit manufacturer's complete published technical data and bulletins for gas fired heating units showing construction, dimensions, weights, capacities, ratings, AFUE, fan performance, electrical characteristics, heat exchanger construction, controls, venting materials and requirements, and accessories provided. Submit manufacturer's complete installation instructions.

C. Submit manufacturer's maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement and spare parts lists. Include this data in the Owner's Operation and Maintenance (O&M) Manuals.

1.05 APPROVED MANUFACTURERS

A. Provide gas fire heating units from the following list of manufacturer's:

B. Gas Fired Furnaces:

1. Bryant
2. Carrier
3. Heil
4. Lennox
5. Trane.

PART 2: PRODUCTS

2.01 GAS FIRED LIGHT COMMERCIAL GRADE FURNACES

A. Provide factory built and factory tested furnace units of types, sizes, capacities, dimensions and characteristics as scheduled on the drawings and specified herein. Furnaces shall be condensing type with two-stage heat and separated combustion venting.

B. Furnaces shall be completely factory assembled and wired, with insulated cabinet housing containing furnace, gas regulator, heat exchanger and fan sections, access doors, filter rack with filter, concentric vent/combustion air intake kit, and motor. The furnace assembly shall include hot surface ignition, combustion air inducer, low voltage redundant gas valve, appliance gas pressure regulator, vent termination kit, control transformer, controls and accessories.

C. Furnace cabinet shall be constructed of heavy gauge cold rolled steel with baked-on enamel finish. Cabinet shall be insulated with black matt faced fiberglass insulation on all sides. Cabinet heating, blower and filter sections shall be easily accessed through removable panels.

D. Furnace gas burners shall be of the inshot type, fabricated from aluminized steel and enclosed in a heavy gauge steel burner box. Provide a sight glass on burner box for flame observation. The burner assembly shall be removable from the furnace unit as a single component. The gas burner shall be standard with furnace with the capacity to develop the full load rating of the furnace. The burner shall be suitable for use with natural gas at pressure available at the project site. Provide a vented or non-vented pressure regulator as allowed by code with each furnace to reduce the gas pressure to that required at the burner.

E. The furnace heat exchanger assembly shall be constructed of heavy gauge aluminized steel mounted in a heavy gauge steel frame. Heat exchanger shall be designed for normal expansion and contraction without metal fatigue. Entire heat exchanger assembly shall be factory tested for leaks in addition to laboratory life cycle tested.

F. Provide forward curved, direct-drive blowers designed for specific airflow volume and static pressures required. Each blower assembly shall be statically and dynamically balanced. Motor shall be resiliently mounted. Change in blower speed shall be accomplished by a simple jumper change at the blower control panel.

G. The furnace filter rack shall be constructed of a heavy gauge steel frame, suitable for receiving either flat or angle type filters. Provide 30% efficient pleated, disposable type filters.

H. Provide cased cooling coil section with refrigerant cooling coil. Frame to be galvanized steel channel A-frame compatible with associated furnace. Coil to have aluminum fins with copper tubing. Refrigerant to be type R-410a.

I. Furnace controls shall be electronic type and include all necessary sensors, switches, circuit boards, relays, circuit breakers, wiring and transformers to fully operate the furnace. All controls shall be housed in a NEMA 1 heavy gauge steel control box. Furnace controls shall include, but not be limited to, fan control, electronic flame sensor, flame rollout switch, safety interlock switch, single-stage heating thermostat and all necessary safeties and control accessories.

J. The furnace shall have a one (1) year factory warranty on parts and labor with a three (3) year warranty on combustion chambers. All gas fired furnaces shall bear the A.G.A./C.S.A. label.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install gas fired heating units in accordance with the manufacturer's most current published installation instructions and in accordance with recognized industry practices to ensure that products serve intended functions.

B. Pipe natural gas to gas fired heating units in accordance with the manufacturer's published instructions in addition to State and local codes. Provide a step-down gas pressure regulator to reduce the pressure from that provided at the site to the pressure required at the unit gas train. Pipe regulator vents to outdoors.

C. Install and wire sensors, thermostat and control panel where shown on the drawings.

D. Coordinate electrical requirements with Division 26 (Electrical) Contractor.

E. Verify proper installation and wiring of gas fired heating units prior to starting units. Do not proceed with start-up until unsatisfactory conditions have been corrected in manner acceptable to Installer.

F. Start-up gas fired heating units in accordance with the manufacturer’s start-up instructions and in the presence of manufacturer’s representative. Test units and controls and demonstrate compliance with requirements. Replace damaged or malfunctioning equipment and controls.

3.02 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 54 00

SECTION 23 55 33

FUEL-FIRED UNIT HEATERS

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes natural gas-fired unit heaters.

1.03 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each type of fuel-fired unit heater indicated. Include rated capacities, operating characteristics, and accessories.

C. Shop Drawings: Include For fuel-fired unit heaters. plans, elevations, sections, details, and attachments to other work.

1. Prepared by or under the supervision of a qualified professional engineer detailing fabrication and assembly of fuel-fired unit heaters, as well as procedures and diagrams.
2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Wiring Diagrams: Power, signal, and control wiring.

D. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Structural members to which equipment will be attached.
2. Items penetrating roof and the following:

    a. Vent and gas piping rough-ins and connections.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For fuel-fired unit heaters to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.05 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace heat exchanger of fuel-fired unit heater that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One for each belt-driven fan size.

PART 2: PRODUCTS

2.01 GAS-FIRED UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lennox Industries, Inc.
2. Modine Manufacturing Company.
3. Reznor/Thomas & Betts Corporation.
4. Sterling HVAC Products; Div. of Mestek Technology Inc.

B. Description: Factory assembled, piped, and wired, and complying with ANSI Z83.8/CSA 2.6.

C. Fuel Type: Design burner for natural gas having characteristics same as those of gas available at Project site.

D. Type of Venting: Indoor, separated combustion, power vented.

E. Housing: Steel, with integral draft hood and inserts for suspension mounting rods.

1. External Casings and Cabinets: Baked enamel or Powder coating over corrosion-resistant-treated surface.
2. Suspension Attachments: Reinforce suspension attachments at connection to fuel-fired unit heaters.

a. Seismic Fabrication Requirements: Fabricate suspension attachments of fuel-fired unit heaters, accessories mountings, and components with reinforcement strong enough to withstand seismic forces defined in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment" when fuel-fired unit heater is anchored to building structure.

F. Heat Exchanger: Aluminized steel.

G. Burner Material: Stainless steel.

H. Unit Fan: Formed-steel propeller blades riveted to heavy-gage steel spider bolted to cast-iron hub, dynamically balanced, and resiliently mounted.

1. Fan-Blade Guard: Galvanized steel, complying with OSHA specifications, removable for maintenance.

2. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Motors: Totally enclosed with internal thermal-overload protection and complying with Division 23 Section "Common Motor Requirements for HVAC Equipment."

b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
c. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

I. Unit Fan: Steel, centrifugal fan dynamically balanced and resiliently mounted.

1. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

a. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
b. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
c. Pulleys: Cast-iron, adjustable-pitch motor pulley.

2. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

a. Motors: Totally enclosed with internal thermal-overload protection and complying with Division 23 Section "Common Motor Requirements for HVAC Equipment."
b. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
c. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

J. Controls: Regulated redundant gas valve containing pilot solenoid valve, electric gas valve, pilot filter, pressure regulator, pilot shutoff, and manual shutoff all in one body.

1. Gas Control Valve: Single stage or Two stage, as applicable.
2. Ignition: Electronically controlled electric spark with flame sensor.
3. Fan Thermal Switch: Operates fan on heat-exchanger temperature.
4. Vent Flow Verification: Differential pressure switch to verify open vent.
5. Control transformer.
6. High Limit: Thermal switch or fuse to stop burner.
7. Thermostats: Devices and wiring are specified in Division 23 Section "Instrumentation and Control for HVAC."
8. Thermostat: Single-stage, wall-mounting type with 50 to 90 deg F (10 to 32 deg C) operating range and fan on switch.
9. Thermostat: 2-stage, wall-mounting type with 50 to 90 deg F (10 to 32 deg C) operating range and fan on switch.

K. Discharge Louvers: Independently adjustable horizontal blades.

L. Accessories:

1. Four-point suspension kit.
2. Summer fan switch.
3. Unit-mounted thermostat bracket.
4. Power Venter: Centrifugal aluminized-steel fan, with stainless-steel shaft; 120-V ac motor.
5. Concentric, Terminal Vent Assembly: Combined combustion-air inlet and power-vent outlet with wall or roof caps. Include adapter assembly for connection to inlet and outlet pipes, and flashing for wall or roof penetration.

M. Capacities and Characteristics:

1. As scheduled on the drawings.

PART 3: EXECUTION

3.01 INSTALLATION

A. Install and connect gas-fired unit heaters and associated fuel and vent features and systems according to NFPA 54 , applicable local codes and regulations, and manufacturer's written installation instructions.

B. Suspended Units: Suspend from substrate using threaded rods, spring hangers, and building attachments. Secure rods to unit hanger attachments. Adjust hangers so unit is level and plumb.

1. Restrain the unit to resist code-required horizontal acceleration.

C. Substrate-Mounted Units: Provide supports connected to substrate. Secure units to supports.

1. Spring hangers are specified in Division 22 Section "Hangers and Supports for HVAC Piping and Equipment."

2. Anchor the unit to resist code-required horizontal acceleration.

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 fuel-fired unit heater to allow service and maintenance.

C. Gas Piping: Comply with Division 23 Section "Facility Natural-Gas Piping." Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.

D. Vent Connections: Comply with Division 23 Section "Breechings, Chimneys, and Stacks."

E. Electrical Connections: Comply with applicable requirements in Division 26 Sections.

1. Install electrical devices furnished with heaters but not specified to be factory mounted.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
2. Verify bearing lubrication.
3. Verify proper motor rotation.
4. Test Reports: Prepare a written report to record the following:

    a. Test procedures used.
    b. Test results that comply with requirements.
    c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

D. Remove and replace malfunctioning units and retest as specified above.

3.04 ADJUSTING

A. Adjust initial temperature set points.

B. Adjust burner and other unit components for optimum heating performance and efficiency.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fuel-fired unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 55 33

SECTION 23 62 00

PACKAGED COMPRESSOR AND CONDENSER UNITS

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.

1.01 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.02 SUMMARY

A. This Section includes air-cooled condensing units.

1.03 SUBMITTALS

A. Refer to specification section 23 05 00 for additional requirements.

B. Product Data: For each condensing unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For condensing units to include in emergency, operation, and maintenance manuals.

E. Warranty: Special warranty specified in this Section.

1.04 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of condensing units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

C. Coordinate location of piping and electrical rough-ins.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2: PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 CONDENSING UNITS, AIR COOLED, 1 TO 5 TONS

A. Manufacturers:

1. Carrier Corporation; Carrier Air Conditioning Div.
2. Lennox Industries Inc.
3. Rheem Manufacturing Air Conditioning Div.
4. Trane Co. (The); Worldwide Applied Systems Group.
5. York International Corp.

B. Description: Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

C. Compressor: Scroll, hermetically sealed, with rubber vibration isolators.

1. Motor: Single speed, and includes thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.

D. Condenser Coil: Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, with removable drain pan and brass service valves with service ports.

E. Condenser Fan: Direct-drive, aluminum propeller fan; with permanently lubricated, totally enclosed fan motor with thermal-overload protection and ball bearings.

F. Accessories:

1. Crankcase heater.

2. Cycle Protector: Automatic-reset timer to prevent rapid compressor cycling.

3. Evaporator Freeze Thermostat: Temperature-actuated switch that stops unit when evaporator reaches freezing temperature.

4. Filter-dryer.

5. High-Pressure Switch: Automatic-reset switch cycles compressor off on high refrigerant pressure.

6. Liquid-line solenoid.

7. Low-Pressure Switch: Automatic-reset switch cycles compressor off on low refrigerant pressure.

8. Thermostatic expansion valve.

9. Time-Delay Relay: Continues operation of evaporator fan after compressor shuts off.

G. Unit Casing: Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.03 MOTORS

A. General requirements for motors are specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 26 Sections.

2.04 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate condensing units according to ARI 210/240 for units less than 135,000 Btu/h and ARI 340/360 for units 135,000 Btu/h and larger.

1. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

B. Test and inspect shell and tube condensers according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

C. Testing Requirements: Factory test sound-power-level ratings according to ARI 270.

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 condensing units.

B. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

C. Examine walls, floors, and roofs for suitable conditions where condensing units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

B. Install condensing units on concrete base where indicated. Concrete base is specified in Division 23 Section "Common Work Results for HVAC," and concrete materials and installation requirements are specified in Division 03.

C. Install roof-mounting units on equipment supports where indicated. Roof supports are specified in Division 07.

D. Vibration Isolation: Install roof mounted condensing units on restrained spring isolators as recommended by the manufacturer.

E. Maintain manufacturer's recommended clearances for service and maintenance.

F. Loose Components: Install electrical components, devices, and accessories that are not factory mounted.

3.03 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 machine to allow service and maintenance.

C. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Division 23 Section "Refrigerant Piping."

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical test and visual and mechanical inspection.

2. Leak Test: After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

5. Verify proper airflow over coils.

B. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

C. Remove and replace malfunctioning condensing units and retest as specified above.

3.05 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

1. Inspect for physical damage to unit casing.
2. Verify that access doors move freely and are weathertight.
3. Clean units and inspect for construction debris.
4. Verify that all bolts and screws are tight.
5. Adjust vibration isolation and flexible connections.
6. Verify that controls are connected and operational.

B. Lubricate bearings on fans.

C. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

D. Adjust fan belts to proper alignment and tension.

E. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

F. Measure and record airflow over coils.

G. Verify proper operation of condenser capacity control device.

H. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

I. After startup and performance test, lubricate bearings[**and adjust belt tension**].

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 23 62 00

SECTION 23 82 33

HEATING TERMINAL UNITS

PART 1: GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 ADDITIONAL REQUIREMENTS

A. Refer to specification section 23 05 00 for additional equipment and project requirements.

1.03 SUMMARY

A. This Section includes the following:

1. Unit heaters.
2. Cabinet heaters.
3. Radiant Floor Heating and Snowmelt Systems

1.04 QUALITY ASSURANCE

A. Codes and Standards:

1. I=B=R Compliance: Test and rate baseboard and finned tube radiation in accordance with I=B=R, provide published ratings bearing emblem of I=B=R.

2. ARI Compliance: Provide coil ratings in accordance with ARI Standard 410 "Forced-Circulation Air-Cooling and Air-Heating Coils".

3. ASHRAE Compliance: Test coils in accordance with ASHRAE Standard 33 "Methods of Testing Forced Circulation Air Cooling and Heating Coils".

4. ARI Compliance: Test and rate fan-coil units in accordance with ARI Standard 440 "Room Fan-Coil Air-Conditioners".

5. UL Compliance: Construct and install fan-coil units in compliance with UL 883 "Safety Standards for Fan Coil Units and Room Fan Heater Units.

6. ARI Compliance: Test and rate unit ventilators in accordance with ARI Standard 330 "Unit Ventilators".

7. UL Compliance: Provide electrical components for terminal units, which have been listed and labeled by UL.

1.05 SUBMITTALS

A. Product Data: Submit manufacturer's specifications for terminal units showing dimensions, capacities, ratings, performance characteristics, gages and finishes of materials, and installation instructions.

B. Shop Drawings: Submit assembly-type shop drawings showing unit dimensions, construction details, and field connection details.

C. Wiring Diagrams submit manufacturer's electrical requirements for power supply wiring to terminal units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Maintenance Data: Submit maintenance instructions, including lubrication instructions, filter replacement, motor and drive replacement, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals in accordance with requirements of Division 1.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Handle terminal units and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged terminal units or components; replace with new.

B. Store terminal units and components in clean dry place. Protect from weather, dirt, fumes, water, construction debris, and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading terminal units, and moving them to final location.

D. Deliver terminal units to job site tagged with label indicating project name, model number, unit number, and details of installation (i.e. room number orientation, etc.).

PART 2: PRODUCTS

2.01 HYDRONIC RADIANT FLOOR HEATING

A. General
   1. Refer to Concrete Division for structural requirements of concrete slabs.
   2. Extent of radiant floor work is indicated by drawings, and by requirements of this Section. Due to variances among the approved in-floor radiant heating system manufacturer’s typical layouts and software programs, the installing contractor shall provide an in-floor radiant heating system layout that meets the zone heat and flow requirements indicated on the drawings. The Contractor’s final layout for each zone shall include the necessary PEX pipe lengths, sizes and number of circuits required to provide a properly distributed in-floor radiant heating system capable of maintaining a zone temperature of 72 °F with an outdoor temperature of -16 °F based on the installed system manufacturer’s recommendations.
   3. Types of radiant floor heating applications for this project include the following:
      a. 1.) Concrete Slab: Five (5) inches or greater in thickness.

B. Radiant Floor Tubing
   1. Provide PEX tubing lengths in locations as indicated on the drawings, with capacities, sizes and spacings as indicated by drawings and/or schedules. Tubing shall be capable of withstanding temperature range of -35°F to 300ºF at 100 psig pressure intermittently without delamination or transfer of expansive forces to surrounding concrete. Tubing shall be UL listed to 180°F and warranted in static hydronic heating applications to 200°F continuous use without detrimental effect. Operating pressure rating shall not be less than 100 psig between 35°F and 180°F. Burst pressure rating shall not be less than 800 psig at 70°F. Tubing shall be crush-proof, recovering its original cross-sectional area and shape without assistance after intermittent flattening due to construction, installation, or site abuse. Tubing shall remain flexible to temperatures as low as -35°F. Tubing shall not support the spread of fire and shall be self-extinguishing. Heat transfer fluids shall only be water or water/glycol mixtures. Use of other heat transfer fluids such as oil, alcohol, or automotive glycol is not permitted.

C. Manifolds
   1. Copper Manifolds: Materials shall be of type L copper trunks and copper or brass base branches with brass tee (sweat) branches, or brass barbs/branches, soldered with high strength solder. Standard diameter is one inch (1”) with other diameters as indicated up to four (4”). Manifolds shall be fitted with ball valves (mini or standard size) and zone valves (electric or non-electric type) for flow control and/or isolation purposes. Manifolds shall be fitted with unions for acceptance of pressure test kits. PEX piping shall be attached to

manifold branches by constant tension clamps and adhesive in accordance with the manufacturer's published installation instructions.

2. Brass Manifolds: Materials shall be of brass trunks fitted with brass base branches, brass ball valves, and brass tee branches, or fitted with brass barb branches. Connections shall be soldered with a lead-free, high strength solder. Standard diameter is one inch (1") with other diameters as indicated up to four inches (4"). Manifolds shall be fitted with ball valves (mini or standard size) and zone valves (electric or non-electric type) for flow control and/or isolation purposes. Manifolds shall be fitted with unions for acceptance of pressure test kits. PEX piping shall be attached to manifold branches by constant tension clamps and adhesive in accordance with the manufacturer's published installation instructions.

D. Accessories
1. Repair Kit: One (1) for each size of radiant floor tubing used in the project.
2. Manifold Mount Bracket: Four (4) per manifold set.
3. Pressure Test Kit: Minimum of one (1). Contractor to determine if more are necessary.
4. Control Valve: Sizes and quantities as indicated (minimum of one per heating zone). Coordinate requirements with Control Systems Contractor.
5. Space Temperature Sensor: Coordinate with the Controls Systems Contractor for the provision of a space temperature sensor. All components shall be compatible with the installed radiant floor/ snow melt system as recommended by the radiant heat system product manufacturer. Control system shall be capable of interfacing with the building energy management system.

E. Recommended Hose Locations
1. Concrete Slab: Secure tubing to rebar by mechanical attachments every eighteen inches (18") and at the midpoint of each turn or bend, with a minimum of two inches (2") of concrete coverage above the top of the tubing. More coverage may be required for higher load requirements.

F. Controls
1. Boiler to operate under its own controls. Primary pump will operate continuously upon a call for heat enable. Zone space temperature sensor to send signal back to control valve to control space temperature. Temperature sensor on supply piping up stream of secondary pump to control water temperature.

2.02 ELECTRIC CABINET HEATERS

A. Manufacturer: Subject to compliance with requirements, provide cabinet heaters of one of the following:

1. Indeeco
2. Markel
3. Marley
4. Berko

B. General: Provide cabinet heaters having cabinet sizes and in locations as indicated, and of capacities, style, and having accessories as scheduled. Include in basic unit chassis, coil, fanboard, fan wheels, housings, motor, motor starter switch and insulation.

C. Coil Section Insulation: Comply with NFPA 90A or NFPA 90B. Unicellular polyethylene thermal plastic, preformed sheet insulation complying with ASTM C 534, Type II, except for density.

1. Thickness: 3/4 inch.

2. Thermal Conductivity (k-Value): 0.24 Btu x in./h x sq. ft. at 75 deg F mean temperature.

3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM C 411.

4. Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect, baked-enamel finish with manufacturer's custom paint, in color selected by Architect.

1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch-thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

3. Recessing Flanges: Steel, finished to match cabinet.

4. Control Access Door: Key operated.

5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.

6. Extended Piping Compartment: 8-inch-wide piping end pocket.

7. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Glass Fiber Treated with Adhesive: 80 percent arrestance and 5 MERV.

F. Electric-Resistance Heating Elements: Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation. Comply with UL 2021 for electric unit heaters and UL 823 for explosion proof electric unit heaters.

1. Circuit Protection: One-time fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

G. Provide a Solid State Relay (Pulse-Width Modulation Signal) to control the line voltage resistive load from a 24VAC control signal or 4to32 VDC signal. The electric element shall act as a fully modulating element from 0-100%

H. Provide remote mounted thermostat and BAS override control

I. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

PART 3: EXECUTION

3.01 INSPECTION

A. Examine areas and conditions under which terminal units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

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3.02 INSTALLATION OF CABINET HEATERS

A. General: Install cabinet heaters as indicated, and in accordance with manufacturer's installation instructions.

B. Locate cabinet heaters as indicated, coordinate with other trades to assure correct recess size for recessed units.

C. Install units plumb and level.

D. Install piping as indicated.

E. Protect units with protective covers during balance of construction.

3.03 CONNECTIONS

A. Piping installation requirements are specified in Division 23 Section "Hydronic Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot-water units and components to piping according to Division 23 Section "Hydronic Piping."

1. Install shutoff valves on inlet and outlet, and balancing valve on outlet.

C. Connect steam units and components to piping according to Division 23 Section "Steam and Condensate Heating Piping."

1. Install shutoff valve on inlet; install strainer, steam trap, and shutoff valve on outlet.

D. Install control valves as required by Division 23 Section "Instrumentation and Control for HVAC."

E. Install piping adjacent to convection heating units to allow service and maintenance.

3.04 ELECTRICAL WIRING

A. General: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electric Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.5 ADJUSTING AND CLEANING

A. General: After construction is completed, including painting, clean unit exposed surfaces, vacuum clean terminal coils and inside of cabinets.

B. Retouch any marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filter units for terminals requiring it.

3.6 DEMONSTRATION AND TRAINING

A. Provide demonstration and training for Owner’s representative in accordance with Division 1 Section "Demonstration and Training."

END OF SECTION 23 82 33

ELECTRICAL TABLE OF CONTENTS

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SECTION 26 0500-COMMON WORK RESULTS FOR ELECTRICAL

PART 1: GENERAL

1.01 ELECTRICAL SCOPE OF WORK

A. The work included under the Electrical Scope of work shall consist of furnishing labor and materials necessary for the complete installation of electrical systems shown on the Contract Documents and as defined and described in the specifications.

B. Include minor items which are obviously and reasonably necessary to complete the installation and usually included in similar work whether or not specifically mentioned in the Contract Documents.

C. Deviations due to a particular manufacturer's requirements shall be provided at no additional cost to the Owner. Electrical equipment dimensions/sizes shall be verified by this Contractor to fit into the space provided prior to shop drawing submittal.

D. Where material quantities are shown, they are for the convenience of the Contractor only. The Contractor shall be responsible to verify all quantities and include as required for a complete installation.

E. Provide both temporary and permanent permits and licenses required for the completion of the work included under this contract. Fees and associated expenses required to obtain such permits shall be paid for by this Contractor.

F. Provide inspections as required by the regulating agencies or where required by Code. Include and pay for all charges, fees, etc and associated costs for inspection agencies. Provide a Certificate of Final Inspection by the Authority Having Jurisdiction (AHJ) and submit a copy to the Engineer/Owner.

1.02 RELATED DOCUMENTS

A. All drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.03 SUMMARY

A. Section Includes:

1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.
6. Temporary power requirements.

1.04 REFERENCES

A. Material and workmanship shall comply with applicable Codes. As a minimum, codes include all State and Federal laws, local ordinances and interpretations of the following by the local Authority Having Jurisdiction (AHJ):

1. State and all local Building Codes.
2. State and Local Fire Codes.
3. National Electrical Code.
4. State and Local Electrical Codes.
5. State Board of Health
6. State Elevator Codes.
7. OSHA regulations.

B. If drawings and/or specifications are in conflict with Code requirements, notify the Engineer prior to shop drawing submittal or rough-in.

C. The following is a list of organizations and their abbreviations where referred to in the specifications as (minimal) standards of construction:

1. ANSI – American National Standards Institute
2. ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers
3. ADA – Americans with Disabilities Act
4. ASTM – American Society for Testing and Materials
5. FM – Factory Mutual
6. IRI – Industrial Risk Insurance
7. IEEE – Institute of Electrical and Electronic Engineers
8. NBFU – National Board of Fire Underwriters
9. NBS – National Bureau of Standards
10. NEC – National Electrical Code
11. NEMA - National Electrical Manufacturer's Association
12. NFPA – National Fire Protection Association
13. OSHA – Occupational Safety and Health Administration
14. UL – Underwriter's Laboratories, Inc
15. Uniform Federal Accessibility Standards

1.05 DEFINITIONS

A. The terms listed below are defined as follows:

1. Furnish: Obtain, coordinate, deliver to the project site and guarantee.
2. Install: Furnished by others, receive on site, unload, store, set in place, connect, place in operation and guarantee workmanship of installation.
3. Provide: To furnish and install.
4. Connect: Bring service to the equipment and make all necessary connections, to include providing required disconnect switches, control switches, outlets, etc.
5. Conduit: Conduit shall include all associated fittings, boxes,

1.06 SUBMITTALS

A. Product Data: For sleeve seals.

B. Refer to specific sections for additional requirements.

1.07 PROJECT SITE CONDITIONS

A. Inspection of Site: Before submitting a bid/proposal on the Work, the Contractor and Subcontractors shall examine the site of the proposed work and thoroughly familiarize themselves with all existing conditions and limitations affecting the performance of their respective work.

B. No extra compensation will be allowed because of a misunderstanding as to the amount of work involved or lack of knowledge of any existing conditions which could have been discovered or reasonably anticipated prior to bidding.

1.08 TEMPORARY ELECTRICAL SERVICES

A. Provide and maintain a complete temporary electrical power service for use by all trades during construction.

B. Refer to General Conditions for responsibilities for energy costs charges.

C. Locate duplex receptacles throughout and on each floor so that any point within the building or construction area can be reached by a 100’-0” extension cord. Provide all duplex receptacles with GFCI protection.

D. Any special service requirements, such as large heating loads, welders, three phase equipment, etc shall be paid for by the Contractor requiring such services.

E. Provide and maintain a complete temporary electrical lighting service for use by all trades during construction.

F. Provide adequate lighting suitable for conditions for high quality workmanship and for safety lighting throughout the areas of construction. Provide minimum requirements of one (1) 200 watt lighting fixture per each 400 square feet or per room.

G. Provide and maintain an exit, egress and safety lighting system where required by code and OSHA.

H. Provide and maintain electrical and telephone service to the construction trailers as defined under the General Conditions.

1.09 WARRANTY

A. Provide guarantee and maintain the stability of workmanship and materials used and keep same in good operating condition for a period of one year after final completion of the work as evidenced by the issuance of the final certificate by the Architect.

B. Correct any deficiencies/defects of any kind immediately and; at the Contractors expense due to faulty workmanship or materials that arise during the above mentioned period of time. Corrections shall be done to the satisfaction of the Engineer/Architect. Such reconstruction and/or repairs shall include damages to the finishes or the building resulting from the original defect.

C. This warranty shall not apply where other warranties for different lengths of time are specifically required under other sections of this specification.

1.010 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. So 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 installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. 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 "Steel Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Firestopping."

1.011 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. 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 Rectangular Openings: Galvanized sheet steel.

1. Minimum Metal Thickness:

    a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
    b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

1.012 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. 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:

    a. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Metraflex Co.
    d. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

1.013 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 2: EXECUTION

2.01 ROUGH-IN

A. Verify all final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected prior to submitting shop drawings. If space provided as indicated on the Contract Document Drawings does not allow for installation, it shall be noted on the shop drawings; all costs associated with relocation to an approved location shall be the responsibility of this Contractor and shall include other Subcontractor's associated costs.

B. Consult the Contract Document Drawings and specifications of all other Divisions and other trades for correlating information and coordinating the layout work so that it will not interfere with other trades and systems.

C. Verify all dimensions and conditions; such as finished ceiling types and heights, wall elevations, sections, footing and foundation elevations, beam depths, ductwork, piping and other facility conditions, with architectural, mechanical and structural Contract Document Drawings. When conflicts occur such that resolution is not possible by the affected trades on site, the Engineer or Architect shall be notified in writing and a resolution will be worked out.

D. When work must be replaced due to failure to verify conditions existing on the job, such replacement shall be accomplished at no additional cost to the Owner. This shall apply to shop fabricated work as well as work fabricated on site.

E. The Electrical Contractor shall add raceway, boxes, light fixtures, etc., to the Mechanical required Coordination Drawings. All costs associated with relocation due to a failure to show all electrical materials on the Coordination Drawings shall be borne by this Contractor.

2.02 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Install all material and equipment in accordance with manufacturer's recommendations, instructions and current NECA and UL standards.

C. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

D. 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.

E. 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.

F. Right of Way: Priority shall be given to piping systems installed at a required slope. Maintain wherever practical a minimum separation of 3" from water and waste piping and 12" from steam and hot water piping.

G. Electrical equipment, including boxes shall not be fastened or attached to ductwork or other mechanical equipment unless noted otherwise.

H. All cutting and patching shall be performed in accordance with requirements of the Contract Documents. Coordinate raceway routing to roof mounted equipment, HVAC equipment, etc., to minimize roof penetrations and to ensure that a water-tight seal or enclosure is maintained. Route electrical through same openings where possible. Exposed routing of raceway on the roof is not allowed without Owner's written approval.

I. Coordinate and arrange with the General Contractor for chases, slots and opening in other building components during the progress of the work to allow for the electrical installations. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components as they are constructed.

J. Install all systems, materials and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished areas.

K. All branch circuits shall be provided with their own neutral. Multi-wire circuits are not allowed, unless specifically indicated.

L. All Critical and Life Safety power shall be run in conduit.

M. All conduits shall have an insulated grounding equipment conductor, sized per NEC 250.

N. Only Hospital Grade MC may be used where allowed by code. Non hospital cables shall not be used.

2.03 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry:

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Sealants and Caulking."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel 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.

M. Underground, Exterior-Wall 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 mechanical sleeve seals.

N. Provide a minimum of three (3) 3” conduit sleeves through each interior wall of all IT/Data Rooms unless noted otherwise.

2.04 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use 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.

2.05 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Utilize Hilti products only. Products shall be installed by a Hilti Certified Installer and properly labeled.

2.06 PROTECTION

A. Contractor shall be responsible for any and all damage of electrical equipment and/or materials and shall keep clean all materials installed by him until final acceptance of the entire building by the Owner. Contractor shall repair or replace damaged materials, finishes, etc., as deemed necessary by the Engineer.

B. When a portion of the building will be occupied by the Owner prior to Substantial Completion of the entire Project, the Owner will assume responsibility for damage to completed electrical installations in construction areas that are to be occupied.

2.07 PAINTING

A. Refinish all electrical equipment damaged during shipping or installation to its original condition as judged by the Engineer. Remove rust, prime and paint per manufacturer's recommendations for a finish equal to the original.

B. Do not paint nameplates, labels, tags, stainless steel or items such as color coded wiring, handles, shafts, terminal strips and trims.

2.08 CLEANING

A. Contractor shall keep the premises free from accumulations of waste materials and construction debris caused by the execution of the Work. The premises shall be cleaned to remove debris and dust from the work every working day, unless more exactly specified else where. In case of deficient action, the Owner may remove the rubbish and charge the Contractor for all costs associated with the action.

B. At the completion of the Work; Contractor shall remove all rubbish, tools, scaffolding and surplus materials from and about the premises within 24 hours of completion.

END OF SECTION 26 0500

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:
1. Section 26 0523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
2. Section 27 1500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 DEFINITIONS

A. VFC: Variable frequency controller.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. Belden Inc.
3. Cerro Wire LLC.
4. Cooper Industries, Inc.
5. General Cable; General Cable Corporation.
6. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN/THWN-2 Type XHHW-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for metal-clad cable, Type MC mineral-insulated, metal-sheathed cable, Type MI with ground wire.

E. VFC Cable:

1. Comply with UL 1277, UL 1685, and NFPA 70 for Type TC-ER cable.
2. Type TC-ER with oversized crosslinked polyethylene insulation, spiral-wrapped foil plus 85 percent coverage braided shields and insulated full-size ground wire, and sunlight- and oil-resistant outer PVC jacket.
3. Comply with UL requirements for cables in Classes I and II, Division 2 hazardous location applications.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. 3M.
2. Hubbell Power Systems, Inc.
3. Ideal Industries, Inc.
4. O-Z/Gedney; a brand of Emerson Industrial Automation.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 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 NFPA 70.

PART 3 - EXECUTION

3.1 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, except VFC cable, which shall be extra flexible stranded.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type XHHW-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type XHHW-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.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 26 0533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. 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.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 26 0529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 26 0536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 CONNECTIONS

A. 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.

B. 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.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 26 0553 "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.

3.6 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 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.7 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 07 8413 "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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 visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
3. Infrared Scanning: After Substantial Completion, but not more than 60 days after 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. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each splice 11 months after date of Substantial Completion.
b. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
c. Record of Infrared Scanning: Prepare a certified report that identifies splices checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

B. Test and Inspection Reports: Prepare a written report 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.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 26 0519

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SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes grounding and bonding systems and equipment.

B. Section includes grounding and bonding systems and equipment, plus the following special applications:

1. Underground distribution grounding.
2. Ground bonding common with lightning protection system.
3. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:
1. Ground rods.
2. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. 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.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Burndy; Part of Hubbell Electrical Systems.
2. ERICO International Corporation.
3. Harger Lightning & Grounding.
4. Thomas & Betts Corporation; A Member of the ABB Group.

2.2 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.

2.3 CONDUCTORS

A. Insulated Conductors: 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 B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch 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 wide and 1/16 inch thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 12 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches 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.

2.4 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. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

PART 3 - EXECUTION

3.1 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. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.

C. Isolated Grounding Conductors: Green-colored insulation with 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 minimum from wall, 6 inches above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

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.

3.2 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.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. 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.
7. Armored and metal-clad cable runs.
8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
9. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.

C. 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.

D. 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.

E. 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.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the

purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. 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.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3.6 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. Ground Rods: Drive rods until tops are 2 inches 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. For grounding electrode system, install at least three rods spaced at least two-rod lengths from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. 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.

D. 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.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Installbonding jumper to bond across flexible duct connections to achieve continuity.

F. 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 apart.

G. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. 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. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at individual ground rods. Make tests at ground rods before any conductors are connected.

    a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    b. Perform tests by fall-of-potential method according to IEEE 81.

4. 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.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Substations and Pad-Mounted Equipment: 5 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 26 0526

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SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

B. Related Requirements:

1. Section 26 0548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 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. Hangers.
b. Steel slotted support systems.
c. Nonmetallic support systems.
d. Trapeze hangers.
e. Clamps.
f. Turnbuckles.
g. Sockets.
h. Eye nuts.
i. Saddles.
j. Brackets.

2. Include rated capacities and furnished specialties and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, 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 hangers and supports will be attached.

3. Size and location of initial access modules for acoustical tile.
4. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.
    f. Cranes

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M.
2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design hanger and support system.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame Rating: Class 1.
2. Self-extinguishing according to ASTM D 635.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. Allied Tube & Conduit; a part of Atkore International.
    b. B-line, an Eaton business.
    c. ERICO International Corporation.
    d. Flex-Strut Inc.
    e. Thomas & Betts Corporation; A Member of the ABB Group.
    f. Unistrut; Part of Atkore International.

2. Material: Galvanized steel.

3. Channel Width: 1-5/8 inches.
4. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

5. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
6. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
8. Channel Dimensions: Selected for applicable load criteria.

B. Aluminum Slotted Support Systems: Comply with MFMA-4 factory-fabricated components for field assembly.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Cooper Industries, Inc.
   b. Flex-Strut Inc.
   c. Thomas & Betts Corporation; A Member of the ABB Group.
   d. Unistrut; Part of Atkore International.

2. Channel Width: 1-5/8 inches.
3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
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.
6. Channel Dimensions: Selected for applicable load criteria.

C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c., in at least one surface.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Allied Tube & Conduit; a part of Atkore International.
   b. B-line, an Eaton business.

2. Channel Width: 1-5/8 inches.

3. Fittings and Accessories: Products provided by channel and angle manufacturer and designed for use with those items.
4. Fitting and Accessory Materials: Same as those for channels and angles, except metal items may be stainless steel.
5. Rated Strength: Selected to suit applicable load criteria.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. 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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M steel plates, shapes, and bars; black and galvanized.

G. 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.

   a. Manufacturers: Subject to compliance with requirements, provide products by the following:

      1) Hilti, Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) B-line, an Eaton business.
      2) Hilti, Inc.

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 A 325.
6. Toggle Bolts: Stainless-steel springhead type.
7. Hanger Rods: Threaded steel.

2.3 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 05 5000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems unless requirements in this Section are stricter.

B. Comply with requirements for raceways and boxes specified in Section 26 0533 "Raceways and Boxes for Electrical Systems."

C. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMTs, IMCs, and RMCs as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

D. 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.

E. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 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, EMTs, IMCs, and RMCs 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.

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. To Existing Concrete: Expansion anchor fasteners.
5. 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
7. To Light Steel: Sheet metal screws.
8. 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. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05 5000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 03 3053 "Miscellaneous 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.

3.5 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.

B. Touchup: Comply with requirements in Section 09 9123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 26 0529

SECTION 26 0533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Section 26 0543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
2. Section 27 0528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.
3. Section 28 0528 "Pathways for Electronic Safety and Security" for conduits, surface pathways, innerduct, boxes, and faceplate adapters serving electronic safety and security.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid steel conduit.

C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

A. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 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. Qualification Data: For professional engineer.

C. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. O-Z/Gedney; a brand of Emerson Industrial Automation.
3. Republic Conduit.
4. Thomas & Betts Corporation; A Member of the ABB Group.
5. Western Tube and Conduit Corporation.
6. Wheatland Tube Company.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch, minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel or.
b. Type: compression.

3. 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.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

K. 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.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Anamet Electrical, Inc.
2. RACO; Hubbell.
3. Thomas & Betts Corporation; A Member of the ABB Group.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
2. Hoffman; a brand of Pentair Equipment Protection.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

D. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

E. Solvent cements and adhesive primers shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 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. Manufacturer's standard enamel finish in color selected by Architect.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated; Wiring Device-Kellems.
b. MonoSystems, Inc.
c. Panduit Corp.
d. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell Incorporated.
b. MonoSystems, Inc.
c. Panduit Corp.
d. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crouse-Hinds, an Eaton business.
2. EGS/Appleton Electric.
3. Hoffman; a brand of Pentair Equipment Protection.
4. Hubbell Incorporated.
5. Milbank Manufacturing Co.
6. MonoSystems, Inc.
7. O-Z/Gedney; a brand of Emerson Industrial Automation.
8. RACO; Hubbell.
9. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation; A Member of the ABB Group.
11. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Nonmetallic Floor Boxes: Nonadjustable, rectangular.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

H. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

I. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

J. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

K. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

L. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

M. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

N. Gangable boxes are prohibited.

O. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R 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.

P. Cabinets:

1. NEMA 250, Type 1 or Type 3R 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.

2.7 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. Manufacturers: Subject to compliance with requirements, provide products by the following:

   a. Quazite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC" or “COMMUNICATIONS”.
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 and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: IMC.

2. Exposted Conduit in the Salt/Sand Structure and Brine Building: RNC, Type EPC-80-PVC
3. Concealed Conduit, Aboveground: IMC.
4. Underground Conduit: RNC, Type EPC-40-PVC,.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
6. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.
3. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following:

   a. Raceways Mounted below 60” AFF in areas or spaces that allow Vehicles (i.e. Vehicle Storage, Maintenance, etc…)
   b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
   c. Mechanical rooms.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: IMC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4x stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch 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 compression, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. 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.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. 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 of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inchesof enclosures to which attached.

I. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-footintervals.
2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from PVC to IMC before rising above floor.

J. 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.

K. 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.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. 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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. 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.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inchradius control at bend points.
2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches 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.

T. 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.

U. 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. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
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 temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. 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.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, 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.

Y. 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.

Z. 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.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. 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.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 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 31 2000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 2000 "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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 2000 "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 of concrete for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

3.4 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 sieve to No. 4 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 above finished grade.

D. Install handholes with bottom below frost line, 5’ below grade.

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.

3.5 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 26 0544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.7 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 26 0533

SECTION 26 0544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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 07 8413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, 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.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.
2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. CALPICO, Inc.
c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: [EPDM] [Nitrile (Buna N)] rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: [Carbon steel] [Plastic] [Stainless steel].
4. Connecting Bolts and Nuts: [Carbon steel, with corrosion-resistant coating,] [Stainless steel] of length required to secure pressure plates to sealing elements.

2.3 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.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 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. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE 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 07 9200 "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 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 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 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 annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 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.

3.3 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 26 0544

SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels, including arc-flash warning labels.
8. Miscellaneous identification products.

1.3 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

2.1 PERFORMANCE REQUIREMENTS

A. Comply with ASME A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 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. 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."

2.3 LABELS

A. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

2.4 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: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Underground-Line Warning Tape
1. Tape:

a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications 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".

2.5 Tags

A. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.

2.6 Signs

A. Laminated Acrylic or Melamine Plastic Signs:

1. Engraved legend.
2. Thickness:

a. For signs up to 20 sq. inches, minimum 1/16-inch-.
b. For signs larger than 20 sq. inches, 1/8 inch thick.
c. Engraved legend with black letters on white face.
d. Self-adhesive.
e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
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, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F according to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.
5. Color: Black.

2.8 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

3.1 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.

3.2 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. 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.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

G. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

H. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

I. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.

J. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

K. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trenchexceeds 16 inches overall.

3.3 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER."
2. "NORMAL POWER."
3. "FIRE ALARM"

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded feeder and branch-circuit conductors.

a. Color shall be factory applied.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

C. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.

D. Install instructional sign, including the color code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker-tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
1. Install underground-line warning tape for direct-buried cables and cables in raceways.

G. Workspace Indication: Install floor marking tape to 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.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm unless equipment is provided with its own identification.

1. Labeling Instructions:

   a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine plastic label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
   b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
   c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   d. Unless labels are provided with self-adhesive means of attachment, fasten them with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. 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 engraved, laminated acrylic or melamine label.
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear.
   e. Switchboards.
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Emergency system boxes and enclosures.
   h. Motor-control centers.
   i. Enclosed switches.
   j. Enclosed circuit breakers.
   k. Enclosed controllers.
   l. Variable-speed controllers.
   m. Push-button stations.
   n. Contactors.
   o. Remote-controlled switches, dimmer modules, and control devices.
   p. Battery-inverter units.
   q. Battery racks.

END OF SECTION 26 0553

SECTION 26 0923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy sensors.
5. Outdoor motion sensors.
6. Lighting contactors.
7. Emergency shunt relays.

B. Related Requirements:

1. Section 26 2726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.

B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 30-A inductive or resistive, 240-V ac.
4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
5. Programs: 8 channels; each channel is individually programmable with eight on-off set points on a 24-hour schedule.
6. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
7. Astronomic Time: All channels.
8. Automatic daylight savings time changeover.
9. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Acuity Brands Controls.
2. The Wattstopper.

B. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Lithonia Lighting; Acuity Brands Lighting, Inc.
2. Sensor Switch, Inc.

3. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast 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.
5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
11. Control Load Status: User selectable to confirm that load wiring is correct.
12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Crestron.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).
b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.
b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.

2.5 INDOOR OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Building Automation, Inc.
2. Lithonia Lighting; Acuity Brands Lighting, Inc.
3. Lutron Electronics Co., Inc.
4. Sensor Switch, Inc.
5. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: 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.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast 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.
5. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.

C. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot-high ceiling.

D. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy .

1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch-high ceiling.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.

E. 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-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

2.6 HIGH-BAY OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, [provide products by the following] [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:

1. Sensor Switch.
2. Wattstopper.

B. General Description: Solid-state unit. The unit is designed to operate with the lamp and ballasts indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Turn lights on to 30-50% when coverage area is occupied, and off when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.
3. Operating Ambient Conditions: 32 to 149 deg F.
4. Mounting: Threaded pipe.
5. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
6. Detector Technology: PIR.
7. Power and dimming control from the lighting fixture ballast that has been modified to include the dimming capacitor and MyzerPORT option.

C. Detector Coverage: User selectable by interchangeable PIR lenses, suitable for mounting heights from 12 to 50 feet.

D. Accessories: Obtain manufacturer's installation and maintenance kit with laser alignment tool for sensor positioning and power port connectors.

2.7 EXTREME-TEMPERATURE OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Sensor Switch, Inc.
2. Wattstopper.

B. Description: wall-mounted, solid-state, extreme-temperature occupancy sensors with a separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended application in damp locations.
2. Operation: 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 30 minutes.
3. Operating Ambient Conditions: From minus 40 to plus 125 deg F.
4. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
5. Power Pack: Dry contacts rated for 20-A ballast 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.
6. Mounting:

    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind cover.

7. Bypass Switch: Override the "on" function in case of sensor failure.
8. Automatic Light-Level Sensor: Adjustable from 2 to 10 fc; keep lighting off when selected lighting level is present.

C. Detector Technology: PIR. Ceiling mounted; detect occupants in coverage area by their heat and movement.

1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
2. Detection Coverage (High Bay): Detect occupancy within 25 feet when mounted on a 25-foot-high ceiling.

2.8 OUTDOOR MOTION SENSORS

A. General Requirements for Sensors: Solid-state outdoor motion sensors.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. PIR type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
3. Switch Rating:

    a. Lighting-Fixture-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent.

4. Switch Type: SP, field selectable automatic "on," or manual "on" automatic "off."
5. Voltage: Match the circuit voltage type.
6. Detector Coverage:

a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..

7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
9. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
10. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
11. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.9 LIGHTING CONTACTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allen-Bradley/Rockwell Automation.
2. Eaton.
3. General Electric Company.
4. Square D.

B. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

C. Interface with DDC System for HVAC: Provide hardware interface to enable the DDC system for HVAC to monitor and control lighting contactors.

1. Monitoring: On-off status
2. Control: On-off operation

2.10 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 26 0519 "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 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller thanNo. 14 AWG. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. 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.

B. 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.

3.2 CONTACTOR INSTALLATION

A. 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.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 26 0553 "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.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. 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.

D. Lighting control devices will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors 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.

3.7 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 26 0943.13 "Addressable-Fixture Lighting Controls" and Section 26 0943.23 "Relay-Based 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 26 0923

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SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

1.2 ACTION SUBMITTALS

A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

B. Shop Drawings: For each switchboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
2. Detail enclosure types for types other than NEMA 250, Type 1.
3. Detail bus configuration, current, and voltage ratings.
4. Detail short-circuit current rating of switchboards and overcurrent protective devices.
5. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
6. Detail utility company's metering provisions with indication of approval by utility company.
7. Include evidence of NRTL listing for series rating of installed devices.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.
10. Include schematic and wiring diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field Quality-Control Reports:

1. Test procedures used.

2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

    a. Routine maintenance requirements for switchboards and all installed components.
    b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
    c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graft paper; include selectable ranges for each type of overcurrent protective device.

1.5 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. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each size and type but no fewer than two of each size and type.
2. Control-Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each size and type but no fewer than three of each size and type.
4. 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.
5. 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.
6. Indicating Lights: Equal to 10 percent of quantity installed for each size and type but no less than one of each size and type.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.

B. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.

B. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.8 FIELD CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards 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.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

a. Ambient Temperature: Not exceeding 104 deg F.
b. Altitude: Not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.9 COORDINATION

A. Coordinate layout and installation of switchboards 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. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SWITCHBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.

2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.
5. EMI
6. AMP

B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.

D. 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.

E. Comply with NEMA PB 2.

F. Comply with NFPA 70.

G. Comply with UL 891.

H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Panel mounted.
2. Branch Devices: Panel mounted.
3. Sections front and rear aligned.

I. Nominal System Voltage: 120/208 V.

J. Main-Bus Continuous: 800 A

K. Outdoor Enclosures: Type 3R.

1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
2. Enclosure: Flat roof; rear hinged doors for each section, with provisions for padlocking.

    a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of -5 deg F.
    b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F with outside design temperature of 90 deg F.
    c. Ventilating openings.
    d. Thermostat: Single stage; wired to control heat and exhaust fan.

3. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer, with spare capacity of 25 percent, within the switchboard. Supply voltage shall be 120/208 V ac.
4. Power for space heaters, ventilation, lighting, and receptacle provided by a remote source.

L. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.

1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
2. Space-Heater Power Source: Transformer, factory installed in switchboard.

M. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.

N. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

O. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

P. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity,.
3. Phase- and Neutral-Bus Material: Tin-plated, high-strength, electrical-grade aluminum alloy with tin-plated aluminum circuit-breaker line connections.
4. Copper feeder circuit-breaker line connections.
5. Ground Bus: Minimum-size required by UL 891, hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Disconnect Links:

    a. Isolate neutral bus from incoming neutral conductors.
    b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.

Q. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.2 SURGE PROTECTION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton.
2. General Electric Company.
3. SIEMENS Industry, Inc.; Energy Management Division.
4. Square D; by Schneider Electric.

B. SPDs: Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.

C. Features and Accessories:
1. Internal thermal protection that disconnects the SPD before damaging internal suppressor components.
2. Indicator light display for protection status.
3. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status.

4. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 200 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. SCCR: Equal or exceed 100 kA.

G. Nominal Rating: 20 kA.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

MDP-1 – BRANCH DEVICES:

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current 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.
2. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
e. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
h. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

MDP-1 – MAIN CIRCUIT BREAKER:

B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.

1. Fixed circuit-breaker mounting.
2. Two-step, stored-energy closing.
3. Full-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:

a. Instantaneous trip.
b. Time adjustments for long- and short-time pickup.
c. Ground-fault pickup level, time delay, and I^2t response.

4. Control Voltage: 120-V ac.

2.4 INSTRUMENTATION

A. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
d. Megawatts: Plus or minus 1 percent.
e. Megavars: Plus or minus 1 percent.
f. Power Factor: Plus or minus 1 percent.
g. Frequency: Plus or minus 0.1 percent.
h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
j. Contact devices to operate remote impulse-totalizing demand meter.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.5 CONTROL POWER

A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

2.7 IDENTIFICATION

A. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.

1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
3. Protect from moisture, dust, dirt, and debris during storage and installation.
4. Install temporary heating during storage per manufacturer's instructions.

B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.

C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1.

B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."

1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
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 concrete base.
3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to switchboards.
6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

F. Install filler plates in unused spaces of panel-mounted sections.

G. Install overcurrent protective devices, surge protection devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

H. Install spare-fuse cabinet.

I. Comply with NECA 1.

3.3 CONNECTIONS

A. Comply with requirements for terminating feeder bus specified in Section 262500 "Enclosed Bus Assemblies." Drawings indicate general arrangement of bus, fittings, and specialties.

B. Comply with requirements for terminating cable trays specified in Section 260536 "Cable Trays for Electrical Systems." Drawings indicate general arrangement of cable trays, fittings, and specialties.

C. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per NFPA 70.

D. Support and secure conductors within the switchboard according to NFPA 70.

E. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Acceptance Testing:

    a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
    b. Test continuity of each circuit.

2. Test ground-fault protection of equipment for service equipment per NFPA 70.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
5. Perform the following infrared scan tests and inspections, and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
    c. Instruments and Equipment:

        1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

B. Switchboard will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 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 indicated.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 262413

SECTION 26 2416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 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.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of panelboard.

1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each panelboard and related equipment.

1. Include dimensioned plans, elevations, sections, and details.
2. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
3. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
4. Detail bus configuration, current, and voltage ratings.

5. Short-circuit current rating of panelboards and overcurrent protective devices.
6. Include evidence of NRTL listing for series rating of installed devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.6 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 01 7823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 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. Keys: Two spares for each type of panelboard cabinet lock.
2. Circuit Breakers Including GFCI and GFEP Types: Four spares for each panelboard.
3. 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.
4. 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.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: ISO 9001 or 9002 certified.

1.9 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 [NECA 407] [NEMA PB 1].

1.10 FIELD CONDITIONS

A. Environmental Limitations:

1. 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.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:

    a. Ambient Temperature: Not exceeding minus 22 deg F to plus 104 deg F.
    b. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than 14 days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.

1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

A. 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.

B. 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.

C. Comply with NEMA PB 1.

D. Comply with NFPA 70.

E. Enclosures: Surface-mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

    a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    b. Outdoor Locations: NEMA 250, Type 4X, Stainless Steel.

2. Height: 84 inches maximum.
3. 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.
4. 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.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:

    a. Panels and Trim: Steel and galvanized 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: Galvanized steel.

F. Incoming Mains:

1. Location: Contractor’s Option.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

G. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.

    a. Plating shall run entire length of bus.
    b. Bus shall be fully rated the entire length.

2. 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.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. 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.

H. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.
4. Main and Neutral Lugs: Compression type, with a lug on the neutral bar for each pole in the panelboard.

5. Ground Lugs and Bus-Configured Terminators: Compression type, with a lug on the bar for each pole in the panelboard.
6. Feed-Through Lugs: Compression type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
7. Subfeed (Double) Lugs: Compression type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
8. Gutter-Tap Lugs: Compression type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.

I. 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.

J. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

1. Percentage of Future Space Capacity: 20 percent.

K. 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.

1. 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.
2. 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.

2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Energy.
3. Square D; by Schneider Electric.
4. Eaton

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.

1. For doors more than 36 inches high, provide two latches, keyed alike.

D. Mains: Lugs only

E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.

F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

G. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Energy.
3. Square D; by Schneider Electric.
4. Eaton

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Mains: Circuit breaker or lugs only.

D. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.

1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
2. External Control-Power Source: 120-V branch circuit.

F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

G. 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.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company; GE Energy Management - Electrical Distribution.
2. Siemens Energy.
3. Square D; by Schneider Electric.
4. Eaton

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers:

a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
3. Electronic Trip Circuit Breakers:

a. RMS sensing.
b. Field-replaceable rating plug or electronic trip.
c. Digital display of settings, trip targets, and indicated metering displays.
d. Multi-button keypad to access programmable functions and monitored data.
e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
f. Integral test jack for connection to portable test set or laptop computer.
g. Field-Adjustable Settings:

1) Instantaneous trip.
2) Long- and short-time pickup levels.
3) Long and short time adjustments.
4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
8. Subfeed Circuit Breakers: Vertically mounted.
9. MCCB Features and Accessories:

a. Standard frame sizes, trip ratings, and number of poles.
b. Breaker handle indicates tripped status.
c. UL listed for reverse connection without restrictive line or load ratings.
d. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
j. Auxiliary Contacts: One, SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
k. Multipole units enclosed in a single housing with a single handle.
l. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
m. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.

2.5 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.

C. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.

1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

2.6 ACCESSORY COMPONENTS AND FEATURES

A. Accessory Set: Include tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 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.

3.2 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:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 03 3000 "Cast-in-Place Concrete."
2. 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 26 0548.16 "Seismic Controls for Electrical Systems."

G. Mount top of trim 90 inches 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. Mounting panelboards with space behind is recommended for damp, wet, or dirty locations. The steel slotted supports in the following paragraph provide an even mounting surface and the recommended space behind to prevent moisture or dirt collection.

K. Mount surface-mounted panelboards to steel slotted supports 5/8 inch in depth. Orient steel slotted supports vertically.

L. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.
2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.

M. 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.

N. Install filler plates in unused spaces.

O. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

P. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

Q. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 26 0553 "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 26 0553 "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 26 0553 "Identification for Electrical Systems."

E. Install warning signs complying with requirements in Section 26 0553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS, Paragraph 7.6 Circuit Breakers. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
c. Instruments and Equipment:

1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

E. Panelboards will be considered defective if they do not pass tests and inspections.

F. 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.

3.5 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 indicated

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.

1. Measure loads during period of normal facility operations.
2. 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.
3. 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.

4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 26 2416

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SECTION 262713 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes equipment for electricity metering by utility company.
   1. Provide a new 800A, 120/208V, 3-phase, 4-wire pad-mounted connection cabinet with provisions for Metering by local utility.
      a. Provide vault and connections as required by local utility between connection cabinet and transformer.
      b. Provide Concrete Pad for Transformer and Connection Cabinet.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For electricity-metering equipment.

   1. Dimensioned plans and sections or elevation layouts.
   2. Wiring Diagrams: For power, signal, and control wiring. Identify terminals and wiring designations and color-codes to facilitate installation, operation, and maintenance. Indicate recommended types, wire sizes, and circuiting arrangements for field-installed wiring, and show circuit protection features.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

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.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and handle modular meter center according to NECA 400.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

   1. Notify Owner no fewer than two weeks in advance of proposed interruption of electrical service.
   2. Do not proceed with interruption of electrical service without Owner's written permission.

1.7 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Meters will be furnished by utility company.

B. Current-Transformer Cabinets: Comply with requirements of electrical-power utility company.

C. Meter Sockets: Comply with requirements of electrical-power utility company.

D. Meter Sockets: Steady-state and short-circuit current ratings shall meet indicated circuit ratings.

E. Modular Meter Center: Factory-coordinated assembly of a main service terminal box with lugs only, wireways, tenant meter socket modules, and tenant feeder circuit breakers arranged in adjacent vertical sections. Assembly shall be complete with interconnecting buses and other features as specified below.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. AMP.
b. E-M-I.

2. Comply with requirements of utility company for meter center.

3. Housing: NEMA 250, Type 3R enclosure.
4. Minimum Short-Circuit Rating: 65,000 A symmetrical at rated voltage.
5. 800A, 120/208V, 3PH, 4W

6. Meter Socket: Rating coordinated with indicated tenant feeder circuit rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install meters furnished by utility company. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

3.2 IDENTIFICATION

A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

1. Series Combination Warning Label: Self-adhesive type, with text as required by NFPA 70.
2. Equipment Identification Labels: Adhesive film labels with clear protective overlay. For residential meters, provide an additional card holder suitable for printed, weather-resistant card with occupant's name.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Electricity metering will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262713

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SECTION 26 2726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Twist-locking receptacles.
3. Receptacles with integral surge-suppression units.
4. Weather-resistant receptacles.
5. Snap switches and wall-box dimmers.
6. Solid-state fan speed controls.
7. Pendant cord-connector devices.
8. Cord and plug sets.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. TVSS: Transient voltage surge suppressor.

F. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 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.

1.7 ADDITIONAL DEVICES

A. Furnish and Install the following additional devices as directed by the engineer as part of the Project.

1. Duplex Receptacles: Provide 10 additional NEMA 5-20R receptacles, surface mounted or recessed, in location directed by engineer. Assume 200' of #10 AWG conductors within ¾"C EMT and 20A/1P located in the nearest panelboard having capacity. At the end of the project an amount of $300 for each receptacle shall be credited back to the owner for each unused receptacle.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton (Arrow Hart).
2. Hubbell Incorporated; Wiring Device-Kellems.
3. Leviton Manufacturing Co., Inc.
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, 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 NFPA 70.

C. 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.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).

b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Eaton (Arrow Hart).
b. Hubbell Incorporated; Wiring Device-Kellems.
c. Leviton Manufacturing Co., Inc.
d. Pass & Seymour/Legrand (Pass & Seymour).

2.5 PENDANT CORD-CONNECTOR DEVICES

A. Description:

1. Matching, locking-type plug and receptacle body connector.
2. NEMA WD 6 Configurations L5-20P and L5-20R, heavy-duty grade, and FS W-C-596.
3. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
4. 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.

2.6 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. 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.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Single Pole:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Eaton (Arrow Hart).
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

2. Two Pole:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Eaton (Arrow Hart).
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

3. Three Way:

   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

      1) Eaton (Arrow Hart).
      2) Hubbell Incorporated; Wiring Device-Kellems.
      3) Leviton Manufacturing Co., Inc.
      4) Pass & Seymour/Legrand (Pass & Seymour).

C. Pilot-Light Switches, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single pole, with neon-lighted handle, illuminated when switch is "off."

D. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches: 120/277 V, 20 A; for use with mechanically held lighting contactors.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Eaton (Arrow Hart).
   b. Hubbell Incorporated; Wiring Device-Kellems.
   c. Leviton Manufacturing Co., Inc.
   d. Pass & Seymour/Legrand (Pass & Seymour).

2.8 WALL PLATES

A. 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: 0.035-inch-thick, satin-finished, Type 302 stainless steel.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.9 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Gray, Or as selected by Architect <color> unless otherwise indicated or required by NFPA 70 or device listing.

B. Wall Plate Color: Satin Stainless Steel

PART 3 - EXECUTION

3.1 INSTALLATION

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 meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:

a. Cut back and pigtail, or replace all damaged conductors.
b. Straighten conductors that remain and remove corrosion and foreign matter.
c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. 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 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.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the left.

F. 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.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

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, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 26 0553 "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.

3.4 FIELD QUALITY CONTROL

A. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 110 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

B. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 26 2726

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SECTION 26 2813 - FUSES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Cartridge fuses rated 600 V ac and less for use in the following:

a. Control circuits.
b. Panelboards.
c. Switchboards.
d. Enclosed controllers.
e. Enclosed switches.

2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

A. 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:

1. 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.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
3. Current-limitation curves for fuses with current-limiting characteristics.
4. 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(SKM) and in PDF format.
5. Coordination charts and tables and related data.
6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.

1. Ambient temperature adjustment information.
2. Current-limitation curves for fuses with current-limiting characteristics.
3. 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.
4. Coordination charts and tables and related data.

1.5 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. Fuses: Equal to 10 Insert number percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

A. Where ambient temperature to which fuses are directly exposed is shall be considered -30F to 105F.

1.7 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Littelfuse, Inc.
3. Mersen USA.

B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

1.8 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

1. Type RK-1: 250-V, zero- to 600-A rating, 200 kAIC, time delay.
2. Type RK-5: 250-V, zero- to 600-A rating, 200 kAIC, time delay.

B. 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.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

1.9 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 2 - EXECUTION

2.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

2.2 FUSE APPLICATIONS

A. Cartridge Fuses:

1. Service Entrance: Class RK1, time delay.
2. Feeders: Class RK5, fast acting.
3. Motor Branch Circuits: Class RK5, time delay.
4. Control Transformer Circuits: Class CC, time delay, control transformer duty.
5. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

2.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s) in main electrical room.

2.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 26 0553 "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 26 2813

SECTION 26 2816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
6. Molded-case switches.
7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
6. 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.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

1.7 CLOSEOUT SUBMITTALS

A. 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 01 7823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
2. 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.

1.8 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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.9 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

C. 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.

D. 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.

E. Comply with NFPA 70.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than 14 days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.11 COORDINATION

A. 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ABB Inc.
2. General Electric Company.
3. Siemens Industry, Inc.
4. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-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.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
5. Lugs: Compression type, suitable for number, size, and conductor material.
6. Service-Rated Switches: Labeled for use as service equipment.
7. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.2 NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 240-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.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.
4. Lugs: Compression type, suitable for number, size, and conductor material.
5. Accessory Control Power Voltage: Remote mounted and powered; 120-V ac.

2.3 SHUNT TRIP SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Bussmann, an Eaton business.
2. Littelfuse, Inc.
3. Mersen USA.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.
2. Oiltight red ON pilot light.
3. Isolated neutral lug; 100 percent rating.
4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
5. Form C alarm contacts that change state when switch is tripped.
6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current 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.

D. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

E. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. 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.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.

2.5 MOLDED-CASE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. Siemens Industry, Inc.
3. Square D; by Schneider Electric.

B. General Requirements: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs: Compression type, suitable for number, size, trip ratings, and conductor material.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and 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.
4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
6. Auxiliary Contacts: One SPDT switch with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.

2.6 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Corrosive Areas(Salt/Sand, Brine): NEMA 250, Type 4X, stainless steel.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 26 0548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 26 0553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3. Perform the following infrared scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION 26 2816

SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes the following enclosed controllers rated 600 V and less:

1. Full-voltage manual.
2. Full-voltage magnetic.

1.3 DEFINITIONS

A. CPT: Control power transformer.

B. MCCB: Molded-case circuit breaker.

C. MCP: Motor circuit protector.

D. N.C.: Normally closed.

E. N.O.: Normally open.

F. OCPD: Overcurrent protective device.

G. SCR: Silicon-controlled rectifier.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of enclosed controller. Include manufacturer's technical data on features, performance, electrical characteristics, ratings, and enclosure types and finishes.

B. Shop Drawings: For each enclosed controller. Include dimensioned plans, elevations, sections, details, and required clearances and service spaces around controller enclosures.

1. Show tabulations of the following:

a. Each installed unit's type and details.
b. Factory-installed devices.
c. Nameplate legends.
d. Short-circuit current rating of integrated unit.
e. Listed and labeled for integrated short-circuit current (withstand) rating of OCPDs in combination controllers by an NRTL acceptable to authorities having jurisdiction.

f. Features, characteristics, ratings, and factory settings of individual OCPDs in combination controllers.

2. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

C. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

D. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor running overload protection suit actual motors to be protected.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 7823 "Operation and Maintenance Data," include the following:

1. Routine maintenance requirements for enclosed controllers and installed components.
2. Manufacturer's written instructions for testing and adjusting circuit breaker and MCP trip settings.
3. Manufacturer's written instructions for setting field-adjustable overload relays.
4. Manufacturer's written instructions for testing, adjusting, and reprogramming reduced-voltage solid-state controllers.

1.7 MATERIALS MAINTENANCE 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. 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.
2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
3. Indicating Lights: Two of each type and color installed.
4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. 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.

C. Comply with NFPA 70.

D. IEEE Compliance: Fabricate and test enclosed controllers according to IEEE 344 to withstand seismic forces defined in Section 26 0548.16 "Seismic Controls for Electrical Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store enclosed controllers indoors in clean, dry space with uniform temperature to prevent condensation. Protect enclosed controllers from exposure to dirt, fumes, water, corrosive substances, and physical damage.

B. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install temporary electric heating, with at least 250 W per controller.

1.10 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.11 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

PART 2 - PRODUCTS

2.1 FULL-VOLTAGE CONTROLLERS

A. General Requirements for Full-Voltage Controllers: Comply with NEMA ICS 2, general purpose, Class A.

B. Motor-Starting Switches: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off or on.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. General Electric Company.
b. Rockwell Automation, Inc.
c. Siemens Industry, Inc.

d. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Surface mounting.
4. Green pilot light.

C. Fractional Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. General Electric Company.
b. Rockwell Automation, Inc.
c. Siemens Industry, Inc.
d. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters matched to nameplate full-load current of actual protected motor; external reset push button; bimetallic type.
4. Surface mounting.
5. Green pilot light.

D. Integral Horsepower Manual Controllers: "Quick-make, quick-break" toggle or push-button action; marked to show whether unit is off, on, or tripped.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. General Electric Company.
b. Rockwell Automation, Inc.
c. Siemens Industry, Inc.
d. Square D; by Schneider Electric.

2. Configuration: Nonreversing.
3. Overload Relays: Inverse-time-current characteristics; NEMA ICS 2, Class 10 tripping characteristics; heaters and sensors in each phase, matched to nameplate full-load current of actual protected motor and having appropriate adjustment for duty cycle; external reset push button; bimetallic type.
4. Surface mounting.
5. Green pilot light.
6. N.O. auxiliary contact.

E. Magnetic Controllers: Full voltage, across the line, electrically held.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. General Electric Company.
b. Rockwell Automation, Inc.
c. Siemens Industry, Inc.
d. Square D; by Schneider Electric.

2. Configuration: Nonreversing.

3. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

    a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.

4. Power Contacts: Totally enclosed, double-break, silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT of sufficient capacity to operate integral devices and remotely located pilot, indicating, and control devices.

    a. CPT Spare Capacity: 100 VA.

6. Bimetallic Overload Relays:

    a. Inverse-time-current characteristic.
    b. Class 10 tripping characteristic.
    c. Heaters in each phase matched to nameplate full-load current of actual protected motor and with appropriate adjustment for duty cycle.
    d. Ambient compensated.
    e. Automatic resetting.

7. N.O., isolated overload alarm contact.
8. External overload reset push button.

F. Combination Magnetic Controller: Factory-assembled combination of magnetic controller, OCPD, and disconnecting means.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

    a. General Electric Company.
    b. Rockwell Automation, Inc.
    c. Siemens Industry, Inc.
    d. Square D; by Schneider Electric.

2. MCCB Disconnecting Means:

    a. UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents; thermal-magnetic MCCB, with inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits.
    b. Front-mounted, adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
    c. Lockable Handle: Accepts three padlocks and interlocks with cover in closed position.
    d. Auxiliary contacts "a" and "b" arranged to activate with MCCB handle.
    e. N.O. alarm contact that operates only when MCCB has tripped.

2.2 ENCLOSURES

A. Enclosed Controllers: NEMA ICS 6, to comply with environmental conditions at installed location.

1. Dry and Clean Indoor Locations: Type 1.
2. Outdoor Locations: Type 3R.
3. Wash-Down or Corrosive Areas: Type 4X, stainless steel.

4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.

2.3 ACCESSORIES

A. General Requirements for Control Circuit and Pilot Devices: NEMA ICS 5; factory installed in controller enclosure cover unless otherwise indicated.

1. Push Buttons, Pilot Lights, and Selector Switches: Heavy-duty, type.

a. Push Buttons: Shrouded types; maintained as indicated.
b. Pilot Lights: LED types; colors as indicated.
c. Selector Switches: Rotary type.

2. Meters: Panel type, 2-1/2-inch minimum size with 90- or 120-degree scale and plus or minus two percent accuracy. Where indicated, provide selector switches with an off position.

B. Reversible N.C./N.O. auxiliary contact(s).

C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.

D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.

E. Breather and drain assemblies, to maintain interior pressure and release condensation in Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

F. Space heaters, with N.C. auxiliary contacts, to mitigate condensation in Type 3R and Type 4X enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.

G. Cover gaskets for Type 1 enclosures.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.

B. Examine enclosed controllers before installation. Reject enclosed controllers that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wall-Mounted Controllers: Install enclosed controllers on walls with tops at uniform height unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding racks complying with Section 26 0529 "Hangers and Supports for Electrical Systems."

B. Install fuses in each fusible-switch enclosed controller.

C. Install fuses in control circuits if not factory installed. Comply with requirements in Section 26 2813 "Fuses."

D. Install heaters in thermal overload relays. Select heaters based on actual nameplate full-load amperes after motors have been installed.

E. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.

F. Comply with NECA 1.

3.3 IDENTIFICATION

A. Identify enclosed controllers, components, and control wiring. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
2. Label each enclosure with engraved nameplate.
3. Label each enclosure-mounted control and pilot device.

3.4 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers and remote devices.

B. Bundle, train, and support wiring in enclosures.

C. Connect selector switches and other automatic-control selection devices where applicable.

1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switch is in manual-control position.
2. Connect selector switches with enclosed-controller circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed controller, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

E. Tests and Inspections:

1. Inspect controllers, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each enclosed-controller element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at controller locations are within plus or minus 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Engineer before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform each electrical test and visual and mechanical inspection stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:

    a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each multi-pole enclosed controller. Remove front panels so joints and connections are accessible to portable scanner.
    b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each multi-pole enclosed controller 11 months after date of Substantial Completion.
    c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Enclosed controllers will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports including a certified report that identifies enclosed controllers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

A. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

B. Adjust overload-relay heaters or settings if power factor correction capacitors are connected to the load side of the overload relays.

C. Adjust the trip settings of MCPs and thermal-magnetic circuit breakers with adjustable instantaneous trip elements. Initially adjust to six times the motor nameplate full-load ampere ratings and attempt to start motors several times, allowing for motor cooldown between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed eight times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Engineer before increasing settings.

D. Set field-adjustable switches and program microprocessors for required start and stop sequences in reduced-voltage solid-state controllers.

3.7 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until enclosed controllers are ready to be energized and placed into service.

B. Replace controllers whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.8 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers, and to use and reprogram microprocessor-based, reduced-voltage solid-state controllers.

END OF SECTION 26 2913

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SECTION 26 5119 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section 26 0923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.
2. Section 26 0926"Lighting Control Panelboards" for panelboards used for lighting control.
3. Section 26 0933"Central Dimming Controls" or Section 26 0936.19 "Standalone Multipreset Modular Dimming Controls" for architectural dimming systems and for fluorescent dimming controls with dimming ballasts specified in interior lighting Sections.
4. Section 26 0943.16"Addressable-Fixture Lighting Controls" and Section 26 0943.23 "Relay-Based Lighting Controls" for manual or programmable control systems with low-voltage control wiring or data communication circuits.

1.3 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.

1.4 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 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. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

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.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:

    a. Other luminaires.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Duct Work.
    f. Cranes

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1.7 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. Lamps: Ten 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.

1.8 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. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 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

2.1 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 for hazardous locations 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. Recessed Fixtures: Comply with NEMA LE 4.

E. Bulb shape complying with ANSI C79.1.

F. Lamp base complying with ANSI C81.61.

G. CRI of minimum 80. CCT of 4100 K.

H. Minimum Rated lamp life of 50,000 hours.

I. Lamps dimmable from 100 percent to 0 percent of maximum light output.

J. Internal driver.

K. Nominal Operating Voltage: 120 V ac.

1. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

2.2 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. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:
1. Acrylic Diffusers: One hundred 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 minimum unless otherwise indicated.

D. 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 for all luminaires.

2.3 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.

2.4 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 0529 "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 steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: 3/16-inch 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

3.1 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 to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

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 vertical force of 400 percent of luminaire weight.

E. Flush-Mounted Luminaire Support:

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 Luminaire Support:

1. Attached to a minimum 20 gauge backing plate attached to wall structural members.
2. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
2. 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.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. 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 26 0519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.5 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.

3.6 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 26 0943.16 "Addressable-Fixture Lighting Controls."

B. Comply with requirements for startup specified in Section 26 0943.23 "Relay-Based Lighting Controls."

3.7 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 26 5119

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SECTION 26 5619 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
2. Luminaire supports.
3. Luminaire-mounted photoelectric relays.

B. Related Requirements:

1. Section 26 0923"Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 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.

1.4 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 LM-79 & IES LM-80.

a. Manufacturer's Certified Data: Photometric data certified by manufacturer’s laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.

b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.

6. Wiring diagrams for power, control, and signal wiring.
7. Photoelectric relays.
8. 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. Product Certificates: For each type of the following:

1. Luminaire.
2. Photoelectric relay.

D. Source quality-control reports.

E. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.

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.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.8 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.

1.9 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 Verify available warranties and warranty periods.

2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 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. Bulb shape complying with ANSI C79.1.

F. CRI of minimum 80. CCT of 4100 K.

G. L70 lamp life of 50,000 hours.

H. Lamps dimmable from 100 percent to 0 percent of maximum light output.

I. Internal driver.

J. Nominal Operating Voltage: 120 V ac.

K. Lamp Rating: Lamp marked for outdoor use.

L. Source Limitations: Obtain luminaires from single source from a single manufacturer.

M. 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.

2.2 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 relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping 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 minimum unless otherwise indicated.

E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.

F. 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.

G. 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.

H. 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.

2.3 FINISHES

A. 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.

B. 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.

C. 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: Dark bronze.

D. 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: As selected by Architect from manufacturer's full range.

2.4 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 26 0529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 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 canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Comply with NECA 1.

B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

C. Install lamps in each luminaire.

D. Fasten luminaire to structural support.

E. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
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.

F. Wall-Mounted Luminaire Support:

1. Attached to a minimum 1/8 inch backing plate attached to wall structural members.

G. Wiring Method: Install cables in raceways. Conceal raceways and cables.

H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated. Install luminaires at height and aiming angle as indicated on Architectural Drawings.

I. Coordinate layout and installation of luminaires with other construction.

J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.

K. Comply with requirements in Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables" and 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 26 0553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

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.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.7 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 26 5619

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SECTION 27 0500
COMMON WORK RESULTS FOR COMMUNICATIONS

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. Communications equipment coordination and installation.
2. Sleeves for pathways and cables.
3. Pillow seals for sleeves.
4. Common communications installation requirements.

1.03 COORDINATION

A. Coordinate arrangement, mounting, and support of communications 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. So connecting pathways, cables, wireways, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for communications items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

PART 2: PRODUCTS

2.01 SLEEVES FOR PATHWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

2.02 SLEEVE SEALS

A. Description: Modular sealing pillows, designed for field assembly, to fill annular space between sleeve and pathway or cable. Provide pillows to seal all sleeves in fire-rated walls and all sleeves over 1” in diameter.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Advance Products & Systems, Inc.
b. Calpico, Inc.
c. Metraflex Co.
d. Pipeline Seal and Insulator, Inc.

PART 3: EXECUTION

3.01 COMMON REQUIREMENTS FOR COMMUNICATIONS 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 communications 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.

3.02 SLEEVE INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Communications penetrations occur when pathways, cables, penetrate concrete slabs, concrete or masonry walls, gypsum walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 4 inches above finished floor level.

G. Size pipe sleeves to provide a minimum of 1/4-inch annular clear space between sleeve and pathway or cable, unless larger size is indicated.

H. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and pathway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants.".

I. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pathway and cable penetrations. Install sleeves and seal pathway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

J. Roof-Penetration Sleeves: Seal penetration of individual pathways and cables with flexible boot-type flashing units applied in coordination with roofing work.

K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.03 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for communications installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION 27 0500

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SECTION 27 0526

GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Grounding conductors.
2. Grounding connectors.
3. Grounding busbars.
4. Grounding rods.
5. Grounding labeling.

1.3 DEFINITIONS

A. BCT: Bonding conductor for telecommunications.

B. EMT: Electrical metallic tubing.

C. TGB: Telecommunications grounding busbar.

D. TMGB: Telecommunications main grounding busbar.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing as-built locations of grounding and bonding infrastructure, including the following:

1. Ground rods.
2. Ground and roof rings.
3. BCT, TMGB, TGBs, and routing of their bonding conductors.

B. Qualification Data: For testing agency and testing agency's field supervisor.

C. Field quality-control reports.

1.5 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 01 7823 "Operation and Maintenance Data," include the following:

    a. Result of the ground-resistance test, measured at the point of BCT connection.
    b. Result of the bonding-resistance test at each TGB and its nearest grounding electrode.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS

A. Comply with J-STD-607-A.

2.2 CONDUCTORS

A. Comply with UL 486A-486B.

B. Insulated Conductors: Stranded copper wire, green or green with yellow stripe insulation, insulated for 600 V, and complying with UL 83.

1. Ground wire for custom-length equipment ground jumpers shall be No. 6 AWG, 19-strand, UL-listed, Type THHN wire.

C. Cable Tray Grounding Jumper:
1. Not smaller than No. 10 AWG and not longer than 12 inches. If jumper is a wire, it shall have a crimped grounding lug with one hole and standard barrel for one crimp. If jumper is a flexible braid, it shall have a one- or two-hole ferrule. Attach with grounding screw or connector provided by cable tray manufacturer.

D. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmils, 14 strands of No. 17 AWG conductor, and 1/4 inch in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
6. Bonding Jumper: Tinned-copper tape, braided conductors terminated with two-hole copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.3 CONNECTORS

A. Manufacturers: Subject to compliance with requirements, [**provide products by the following**] [**provide products by one of the following**] [**available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following**]:

1. Burndy; Part of Hubbell Electrical Systems.
2. Chatsworth Products, Inc.

3. Harger Lightning & Grounding.
4. Panduit Corp.
5. TE Connectivity Ltd.

B. Irreversible connectors listed for the purpose. Listed by an NRTL as complying with NFPA 70 for specific types, sizes, and combinations of conductors and other items connected. Comply with UL 486A-486B.

C. Compression Wire Connectors: Crimp-and-compress connectors that bond to the conductor when the connector is compressed around the conductor. Comply with UL 467.

1. Electroplated tinned copper, C and H shaped.

D. Signal Reference Grid Connectors: Combination of compression wire connectors, access floor grounding clamps, bronze U-bolt grounding clamps, and copper split-bolt connectors, designed for the purpose.

E. Busbar Connectors: Cast silicon bronze, solderless compression-type, mechanical connector; with a long barrel and two holes spaced on 5/8- or 1-inch centers for a two-bolt connection to the busbar.

F. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING BUSBARS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Chatsworth Products, Inc.
2. Harger Lightning & Grounding.
3. Panduit Corp.

B. TMGB: Predrilled, wall-mounted, rectangular bars of hard-drawn solid copper, 1/4 by 4 inches in cross section, length of 24”. The busbar shall be NRTL listed for use as TMGB and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide a 4-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

C. TGB: Predrilled rectangular bars of hard-drawn solid copper, 1/4 by 2 inches in cross section, length as indicated on Drawings. The busbar shall be for wall mounting, shall be NRTL listed as complying with UL 467, and shall comply with J-STD-607-A.

1. Predrilling shall be with holes for use with lugs specified in this Section.
2. Mounting Hardware: Stand-off brackets that provide at least a 2-inch clearance to access the rear of the busbar. Brackets and bolts shall be stainless steel.
3. Stand-off insulators for mounting shall be Lexan or PVC. Comply with UL 891 for use in 600-V switchboards, impulse tested at 5000 V.

D. Rack and Cabinet Grounding Busbars: Rectangular bars of hard-drawn solid copper, accepting conductors ranging from No. 14 to No. 2/0 AWG, NRTL listed as complying with UL 467, and complying with J-STD-607-A. Predrilling shall be with holes for use with lugs specified in this Section.

1. Cabinet-Mounted Busbar: Terminal block, with stainless-steel or copper-plated hardware for attachment to the cabinet.
2. Rack-Mounted Horizontal Busbar: Designed for mounting in 19- or 23-inch equipment racks. Include a copper splice bar for transitioning to an adjoining rack, and stainless-steel or copper-plated hardware for attachment to the rack.
3. Rack-Mounted Vertical Busbar: 72 or 36 inches long, with stainless-steel or copper-plated hardware for attachment to the rack.

2.5 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the ac grounding electrode system and equipment grounding for compliance with requirements for maximum ground-resistance level and other conditions affecting performance of grounding and bonding of the electrical system.

B. Inspect the test results of the ac grounding system measured at the point of BCT connection.

C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

D. Proceed with connection of the BCT only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Bonding shall include the ac utility power service entrance, the communications cable entrance, and the grounding electrode system. The bonding of these elements shall form a loop so that each element is connected to at least two others.

B. Comply with NECA 1.

C. Comply with J-STD-607-A.

3.3 APPLICATION

A. Conductors: Install solid conductor for No. 8 AWG and smaller and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

1. The bonding conductors between the TGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.
2. The bonding conductors between the TMGB and structural steel of steel-frame buildings shall not be smaller than No. 6 AWG.

B. Underground Grounding Conductors: Install barecopper conductor, No. 2 AWG minimum.

C. 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.

D. Conductor Support:

1. Secure grounding and bonding conductors at intervals of not less than 36 inches.

E. Grounding and Bonding Conductors:

1. Install in the straightest and shortest route between the origination and termination point, and no longer than required. The bend radius shall not be smaller than eight times the diameter of the conductor. No one bend may exceed 90 degrees.
2. Install without splices.
3. Support at not more than 36-inch intervals.
4. Install grounding and bonding conductors in 3/4-inch PVC conduit until conduit enters a telecommunications room. The grounding and bonding conductor pathway through a plenum shall be in EMT. Conductors shall not be installed in EMT unless otherwise indicated.

    a. If a grounding and bonding conductor is installed in ferrous metallic conduit, bond the conductor to the conduit using a grounding bushing that complies with requirements in Section 27 0528 "Pathways for Communications Systems," and bond both ends of the conduit to a TGB.

3.4 GROUNDING ELECTRODE SYSTEM

A. The BCT between the TMGB and the ac service equipment ground shall not be smaller than No. 3/0 AWG.

3.5 GROUNDING BUSBARS

A. Indicate locations of grounding busbars on Drawings. Install busbars horizontally, on insulated spacers 2 inches minimum from wall, 12 inches above finished floor unless otherwise indicated.

B. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

3.6 CONNECTIONS

A. Bond metallic equipment in a telecommunications equipment room to the grounding busbar in that room, using equipment grounding conductors not smaller than No. 6 AWG.

B. Stacking of conductors under a single bolt is not permitted when connecting to busbars.

C. Assemble the wire connector to the conductor, complying with manufacturer's written instructions and as follows:

1. Use crimping tool and the die specific to the connector.
2. Pretwist the conductor.
3. Apply an antioxidant compound to all bolted and compression connections.

D. Primary Protector: Bond to the TMGB with insulated bonding conductor.

E. Interconnections: Interconnect all TGBs with the TMGB with the telecommunications backbone conductor. If more than one TMGB is installed, interconnect TMGBs using the grounding equalizer conductor. The telecommunications backbone conductor and grounding equalizer conductor size shall not be less than 2 kcmils/linear foot of conductor length, up to a maximum size of No. 3/0 AWG unless otherwise indicated.

F. Telecommunications Enclosures and Equipment Racks: Bond metallic components of enclosures to the telecommunications bonding and grounding system. Install top-mounted rack grounding busbar unless the enclosure and rack are manufactured with the busbar. Bond the equipment grounding busbar to the TGB No. 2 AWG bonding conductors.

G. Structural Steel: Where the structural steel of a steel frame building is readily accessible within the room or space, bond each TGB and TMGB to the vertical steel of the building frame.

H. Electrical Power Panelboards: Where an electrical panelboard for telecommunications equipment is located in the same room or space, bond each TGB to the ground bar of the panelboard.

I. Shielded Cable: Bond the shield of shielded cable to the TGB in communications rooms and spaces. Comply with TIA/EIA-568-B.1 and TIA/EIA-568-B.2 when grounding screened, balanced, twisted-pair cables.

J. Rack- and Cabinet-Mounted Equipment: Bond powered equipment chassis to the cabinet or rack grounding bar. Power connection shall comply with NFPA 70; the equipment grounding conductor in the power cord of cord- and plug-connected equipment shall be considered as a supplement to bonding requirements in this Section.

K. Access Floors: Bond all metal parts of access floors to the TGB.

3.7 IDENTIFICATION

A. Labels shall be preprinted or computer-printed type.

1. Label TMGB(s) with "fs-TMGB," where "fs" is the telecommunications space identifier for the space containing the TMGB.
2. Label TGB(s) with "fs-TGB," where "fs" is the telecommunications space identifier for the space containing the TGB.
3. Label the BCT and each telecommunications backbone conductor at its attachment point: "WARNING! TELECOMMUNICATIONS BONDING CONDUCTOR. DO NOT REMOVE OR DISCONNECT!"

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
2. Test the bonding connections of the system using an ac earth ground-resistance tester, taking two-point bonding measurements in each telecommunications equipment room containing a TMGB and a TGB and using the process recommended by BICSI TDMM. Conduct tests with the facility in operation.

    a. Measure the resistance between the busbar and the nearest available grounding electrode. The maximum acceptable value of this bonding resistance is 100 milliohms.

3. Test for ground loop currents using a digital clamp-on ammeter, with a full-scale of not more than 10 A, displaying current in increments of 0.01 A at an accuracy of plus/minus 2.0 percent.

    a. With the grounding infrastructure completed and the communications system electronics operating, measure the current in every conductor connected to the TMGB and in each TGB. Maximum acceptable ac current level is 1 A.

C. Excessive Ground Resistance: If resistance to ground at the BCT exceeds 5 ohms, notify Architect promptly and include recommendations to reduce ground resistance.

D. Grounding system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 27 0526

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SECTION 27 0528

PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Horizontal Communications cables are shall be distributed with J-Hooks above ceilings where practical. Utilize EMT where exposed or otherwise not accessible.

B. Section Includes:

1. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Optical-fiber-cable pathways and fittings.
4. Metal wireways and auxiliary gutters.
5. Nonmetallic wireways and auxiliary gutters.
6. Metallic surface pathways.
7. Hooks.
8. Boxes, enclosures, and cabinets.
9. Polymer-concrete handholes and boxes for exterior underground cabling.

1.3 DEFINITIONS

A. ARC: Aluminum rigid conduit.

B. GRC: Galvanized rigid conduit.

C. IMC: Intermediate metal conduit.

D. RTRC: Reinforced thermosetting resin conduit.

1.4 ACTION SUBMITTALS

A. Product data for the following:

1. Surface pathways
2. Wireways and fittings.
3. Boxes, enclosures, and cabinets.
4. Underground handholes and boxes.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Description: Metal raceway of circular cross section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. O-Z/Gedney; a brand of Emerson Industrial Automation.
3. Republic Conduit.
4. Thomas & Betts Corporation; A Member of the ABB Group.
5. Wheatland Tube Company.

C. General Requirements for Metal Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by a nationally recognized testing laboratory, and marked for intended location and application.
2. Comply with TIA-569-D.

D. GRC: Comply with ANSI C80.1 and UL 6.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with ANSI C80.3 and UL 797.

G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.
b. Type: Set screw or compression.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

H. 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.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Description: Nonmetallic raceway of circular section with manufacturer-fabricated fittings.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube & Conduit; a part of Atkore International.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Kraloy.
4. RACO; Hubbell.

5. Thomas & Betts Corporation; A Member of the ABB Group.

C. General Requirements for Nonmetallic Conduits and Fittings:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. Continuous HDPE: Comply with UL 651A.

F. RTRC: Comply with UL 2515A and NEMA TC 14.

G. Fittings: Comply with NEMA TC 3; match to conduit or tubing type and material.

H. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 OPTICAL-FIBER-CABLE PATHWAYS AND FITTINGS

A. Description: Comply with UL 2024; flexible-type pathway with a circular cross section, approved for plenum installation unless otherwise indicated.

B. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

C. Comply with TIA-569-D.

2.4 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Description: Sheet metal trough of rectangular cross section fabricated to required size and shape, without holes or knockouts, and with hinged or removable covers.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of Pentair Equipment Protection.
3. MonoSystems, Inc.
4. Square D; by Schneider Electric.

C. General Requirements for Metal Wireways and Auxiliary Gutters:

1. Comply with UL 870 and NEMA 250, Type 1 unless otherwise indicated, and sized according to NFPA 70.
2. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-D.

D. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

E. Wireway Covers: Hinged type unless otherwise indicated.

F. Finish: Manufacturer's standard enamel finish.

2.5 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

B. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Moulded Products, Inc.
2. Carlon; a brand of Thomas & Betts Corporation.
3. Hoffman; a brand of Pentair Equipment Protection.

D. General Requirements for Nonmetallic Wireways and Auxiliary Gutters:

1. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Comply with TIA-569-D.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

2.6 SURFACE METAL PATHWAYS

A. Description: Galvanized steel with snap-on covers, complying with UL 5.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.
2. Panduit Corp.
3. Wiremold / Legrand.

C. Finish: Manufacturer's standard enamel finish in color selected by Architect.

D. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

E. Comply with TIA-569-D.

2.7 SURFACE NONMETALLIC PATHWAYS:

A. Description: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlon; a brand of Thomas & Betts Corporation.
2. MonoSystems, Inc.

3. Panduit Corp.
4. Quazite: Hubbell Power Systems, Inc.
5. Wiremold / Legrand.

C. Finish: Texture and color selected by Architect from custom colors.

D. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

E. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

F. Comply with TIA-569-D.

2.8 HOOKS

A. Description: Prefabricated sheet metal cable supports for telecommunications cable.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. MonoSystems, Inc.
2. Panduit Corp.
3. Wiremold / Legrand.

C. Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with TIA-569-D.

E. Galvanized steel.

F. J shape.

2.9 BOXES, ENCLOSURES, AND CABINETS

A. Description: Enclosures for communications.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carlon; a brand of Thomas & Betts Corporation.
2. Crouse-Hinds, an Eaton business.
3. EGS/Appleton Electric.
4. Hoffman; a brand of Pentair Equipment Protection.
5. Milbank Manufacturing Co.
6. MonoSystems, Inc.
7. O-Z/Gedney; a brand of Emerson Industrial Automation.
8. Quazite: Hubbell Power Systems, Inc.
9. Spring City Electrical Manufacturing Company.
10. Thomas & Betts Corporation; A Member of the ABB Group.
11. Wiremold / Legrand.

C. General Requirements for Boxes, Enclosures, and Cabinets:

1. Comply with TIA-569-D.

2. Boxes, enclosures, and cabinets installed in wet locations shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for use in wet locations.
3. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
4. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
5. Gangable boxes are prohibited.

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. Metal Floor Boxes:

1. Material: Cast metal or sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

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. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

J. 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:

a. Material: Plastic.
b. Finished inside with radio-frequency-resistant paint.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

K. 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.

2.10 POLYMER-CONCRETE HANDHOLES

A. Description: Molded of sand and aggregate; bound together with polymer resin; and reinforced with steel, fiberglass, or a combination of the two.

B. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Quazite: Hubbell Power Systems, Inc.

C. General Requirements for Polymer Concrete Handholes:

1. Boxes and handholes for use in underground systems shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.
3. Comply with TIA-569-D.

D. Configuration: Designed for flush burial with open bottom unless otherwise indicated.

E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

1. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
2. Cover Legend: Molded lettering, "COMMUNICATIONS".

F. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

G. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.11 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Tests of materials shall be performed by an independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PATHWAY APPLICATION

A. Outdoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed Conduit: IMC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-40-PVC,.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply pathway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: EMT.

3. Exposed and Subject to Severe Physical Damage: IMC. Pathway locations include the following:

    a. Any space subjected to vehicle traffic; provide IMC within 60” AFF.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT or J-Hooks.
5. Damp or Wet Locations: IMC.
6. Pathways for Optical-Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
7. Pathways for Optical-Fiber or Communications-Cable Risers in Vertical Shafts: Riser-type, optical-fiber-cable pathway or EMT.
8. Pathways for Concealed General-Purpose Distribution of Optical-Fiber or Communications Cable: General-use, optical-fiber-cable pathway EMT.
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel units in commercial kitchens and damp or wet locations.

C. Minimum Pathway Size: 3/4-inch trade size for copper and aluminum cables, and 1 inch for optical-fiber cables.

D. Pathway Fittings: Compatible with pathways 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 set-screw or compression, steel fittings. Comply with NEMA FB 2.10.

E. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

F. Install surface pathways only where indicated on Drawings.

G. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with the following standards for installation requirements except where requirements on Drawings or in this Section are stricter:

1. NECA 1.
2. NECA/BICSI 568.
3. TIA-569-D.
4. NECA 101

B. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.

C. Comply with requirements in Section 07 8413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

D. Comply with requirements in Section 27 0528.29 "Hangers and Supports for Communications Systems" for hangers and supports.

E. Comply with requirements in Section 27 0544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling" for sleeves and sleeve seals for communications.

F. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.

G. Complete pathway installation before starting conductor installation.

H. Arrange stub-ups so curved portions of bends are not visible above finished slab.

I. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.

J. Conceal rigid conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Pathways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure pathways to reinforcement at maximum 10-foot intervals.
2. Arrange pathways to cross building expansion joints at right angles with expansion fittings. Comply with requirements for expansion joints specified in this article.
3. Arrange pathways to keep a minimum of 2 inches of concrete cover in all directions.
4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
5. Change from nonmetallic conduit and fittings to IMC and fittings before rising above floor.

M. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for pathways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.

O. Coat field-cut threads on PVC-coated pathway with a corrosion-preventing conductive compound prior to assembly.

P. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.

Q. 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.

R. Cut conduit perpendicular to the length. For conduits of 2-inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.

S. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Secure pull wire, so it cannot fall into conduit. Cap pathways designated as spare alongside pathways in use.

T. Surface Pathways:

1. Install surface pathway for surface telecommunications outlet boxes only where indicated on Drawings.
2. Install surface pathway with a minimum 2-inch radius control at bend points.
3. Secure surface pathway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight pathway section. Support surface pathway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

U. Pathways for Optical-Fiber and Communications Cable: Install pathways, metal and nonmetallic, rigid and flexible, as follows:

1. 3/4-Inch Trade Size and Smaller: Install pathways in maximum lengths of 50 feet.
2. 1-Inch Trade Size and Larger: Install pathways in maximum lengths of 75 feet.
3. Install with a maximum of two 90-degree bends or equivalent for each length of pathway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

V. Install pathway-sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, 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 pathway-sealing fittings according to NFPA 70.

W. Install devices to seal pathway 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 pathways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where an underground service pathway enters a building or structure.
3. Where otherwise required by NFPA 70.

X. Comply with manufacturer's written instructions for solvent welding PVC conduit and fittings.

Y. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F, and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT that is located where environmental temperature change may exceed 100 deg F, and that has straight-run length that exceeds 100 feet.
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 temperature change.
    b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
    c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
    d. Attics: 135 deg F temperature change.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F 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 of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. 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.

Z. Hooks:

1. Size to allow a minimum of 25 percent future capacity without exceeding design capacity limits.
2. Shall be supported by dedicated support wires. Do not use ceiling grid support wire or support rods.
3. Hook spacing shall allow no more than 6 inches of slack. The lowest point of the cables shall be no less than 6 inches adjacent to ceilings, mechanical ductwork and fittings, luminaires, power conduits, power and telecommunications outlets, and other electrical and communications equipment.
4. Space hooks no more than 5 feet o.c.
5. Provide a hook at each change in direction.

AA. 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.

BB. 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 surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

CC. Horizontally separate boxes mounted on opposite sides of walls, so they are not in the same vertical channel.

DD. 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.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set metal floor boxes level and flush with finished floor surface.

GG. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 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 31 2000 "Earth Moving" for pipe of less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 31 2000 "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 of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 31 2000 "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 of concrete around conduit for a minimum of 12 inches 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 from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 27 0553 "Identification for Communications Systems."

3.4 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 sieve to No. 4 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 above finished grade.

D. Install handholes with bottom below frost line, below grade.

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.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR COMMUNICATIONS PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 27 0544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 07 8413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage or 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 27 0528

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SECTION 27 1100
COMMUNICATIONS EQUIPMENT ROOM FITTINGS

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. Telecommunications mounting elements.
2. Backboards.
3. Telecommunications equipment racks and cabinets.
4. Telecommunications service entrance pathways.
5. Grounding.

B. Related Sections:

1. Division 27 13 13 Section "Communications Copper Backbone Cabling" for voice and data cabling associated with system panels and devices.

2. Division 27 13 23 Section "Communications Optical Fiber Backbone Cabling" for voice and data cabling associated with system panels and devices.

3. Division 27 15 00 Section "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

4. Division 28 05 13 Section "Conductors and Cables for Electronic Safety and Security" for voice and data cabling associated with system panels and devices.

1.03 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks and cabinets. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For communications equipment room fittings. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Equipment Racks and Cabinets: Include workspace requirements and access for cable connections.

3. Grounding: Indicate location of grounding bus bar and its mounting detail showing standoff insulators and wall mounting brackets.

C. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings shall be under the direct supervision of RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

3. Field Inspector: Currently registered by BICSI as RCDD to perform the on-site inspection.

B. 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.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

1.07 COORDINATION

A. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.

2. Record agreements reached in meetings and distribute them to other participants.

3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

B. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

PART 2: PRODUCTS

2.01 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.
2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. Lacing bars, spools, J-hooks, and D-rings.
4. Straps and other devices.

C. Conduit and Boxes: Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems."

1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/4 inches deep.

2.02 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 06 Section "Rough Carpentry." Paint with (2) coats gray paint.

2.03 EQUIPMENT FRAMES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ADC.
2. Aim Electronics; a brand of Emerson Electric Co.
3. AMP; a Tyco International Ltd. company.
4. Cooper B-Line, Inc.
5. Hubbell Premise Wiring.
6. KRONE Incorporated.
7. Leviton Voice & Data Division.
8. Middle Atlantic Products, Inc.
9. Nordex/CDT; a subsidiary of Cable Design Technologies.
10. Ortronics, Inc.
11. Panduit Corp.
12. Siemon Co. (The).

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.

2. Module Dimension: Width compatible with EIA 310 standard, 19-inch panel mounting.

3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug, and a power strip.

2. Baked-polyester powder coat finish.

D. Modular Freestanding Cabinets:

1. Removable and lockable side panels.
2. Hinged and lockable front and rear doors.
3. Adjustable feet for leveling.
4. Screened ventilation openings in the roof and rear door.
5. Cable access provisions in the roof and base.
6. Grounding bus bar.
7. Rack mounted, 550-cfm fan with filter.
8. Power strip.
9. Baked-polyester powder coat finish.
10. All cabinets keyed alike.

E. Modular Wall Cabinets:

1. Wall mounting.
2. Steel construction.
3. Treated to resist corrosion.
4. Lockable front and rear doors.
5. Louvered side panels.
6. Cable access provisions top and bottom.
7. Grounding lug.
8. Rack-mounted, 250-cfm fan.
9. Power strip.
10. All cabinets keyed alike.

F. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.

2. Baked-polyester powder coat finish.

3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.04 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Rack mounting.

2. Six, 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.

3. LED indicator lights for power and protection status.

4. LED indicator lights for reverse polarity and open outlet ground.

5. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.

6. Close-coupled, direct plug-in line cord.

7. Rocker-type on-off switch, illuminated when in on position.

8. Peak Single-Impulse Surge Current Rating: 13 kA per phase.

9. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all 3 modes shall be not more than 330 V.

2.05 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems." for grounding conductors and connectors.

B. Provide a telecommunications Ground Bus Bar in each Telecommunications (Voice and/or Data) Room:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide by 12” long with 9/32-inch holes spaced 1-1/8 inches apart.

3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.06 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers

PART 3: EXECUTION

3.01 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Cable Trays: Comply with NEMA VE 2 and TIA/EIA-569-A-7.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.02 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."Comply with TIA/EIA-569-A, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.03 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.04 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 26 Section "Identification for Electrical Systems." Comply with requirements in Division 09 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

B. See Division 27 Section "Communications Horizontal Cabling" for additional identification requirements. See Evaluations for discussion of TIA/EIA standard as it applies to this Section. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

C. Labels shall be preprinted or computer-printed type.

END OF SECTION 27 1100

SECTION 27 1500

COMMUNICATIONS HORIZONTAL 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 SCOPE

A. Provide new devices indicated on plans with a new patch panel in new racks. There will be (2) Floor mounted 19" racks within the main IT room.

1.03 SUMMARY

A. Section Includes:

1. Pathways.
2. UTP cabling.
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

1.04 DEFINITIONS

A. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

B. EMI: Electromagnetic interference.

C. IDC: Insulation displacement connector.

D. LAN: Local area network.

E. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

F. UTP: Unshielded twisted pair.

1.05 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called "permanent link," a term that is used in the testing protocols.

1. Bridged taps and splices shall not be installed in the horizontal cabling.

B. Each voice/data outlet (1/2 shaded triangle) shall have three (3) data jacks and cables (unless noted otherwise).

C. Each multi Data outlet (open triangle) shown on the plans shall have 2 data jacks and cables (unless noted otherwise).

D. Each Wireless Access Point outlet (open triangle w/ WAP) shown on the plans shall have 2 data jacks and cables (unless noted otherwise).

E. Each single Data outlet (fully shaded triangle) shown on the plans shall have 1 data jacks and cable (unless noted otherwise).

F. Each TV outlet shown on the plans shall have (1) Data Jack and (1) coax jacks and cable routed to the IT room (unless noted otherwise).

G. Each outlet box shall be a minimum of 4" x 4" x 2¼" with a single gang mud ring and faceplate. All devices shall be modular. Each outlet box shall have 1" conduit stubbed to above accessible ceiling space with a nylon bushing, unless indicated otherwise.

H. The maximum allowable horizontal cable length is 295 feet. This maximum allowable length does not include an allowance for the length of 16 feet to the workstation equipment. The maximum allowable length does not include an allowance for the length of 16 feet in the horizontal cross-connect.

1.06 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with Category 6 transmission standards in TIA/EIA-568-C.2, when tested according to test procedures of this standard.

1.07 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. System Labeling Schedules: Electronic copy of labeling schedules, in software and format selected by Owner.

2. Wiring diagrams to show typical wiring schematics, including the following:

   a. Cross-connects.
   b. Patch panels.
   c. Patch cords.

3. Cross-connects and patch panels. Detail mounting assemblies, and show elevations and physical relationship between the installed components.

C. Samples: For workstation outlets, jacks, jack assemblies, in specified finish, one for each size and outlet configuration.

D. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

E. Source quality-control reports.

F. Field quality-control reports.

G. Maintenance Data: For splices and connectors to include in maintenance manuals.

H. As-Builts: Provide complete electronic and hard copies of as-built drawings (floor plans) indicating all horizontal cabling, devices, labeling, and backbone cabling.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings, by an RCDD.

2. Installation Supervision: Installation shall be under the direct supervision of Level 2 Installer, who shall be present at all times when Work of this Section is performed at Project site.

B. 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.

C. Telecommunications Pathways and Spaces: Comply with TIA/EIA-569-A.

D. Grounding: Comply with ANSI-J-STD-607-A.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.

1. Test each pair of UTP cable for open and short circuits.

1.010 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.11 COORDINATION

A. Coordinate layout and installation of telecommunications pathways and cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.12 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Provide (3) complete voice/data outlets to be installed during construction. Exact locations to be determined in the field, estimate 100’ from telecom room. Each outlet shall have two data. A credit of $300.00/outlet shall be required at Project Close-Out for any unused outlets.

PART 2: PRODUCTS

2.01 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Provide 1" metal conduit sleeves from main corridors to every room requiring voice/data devices. Sleeves shall be located above accessible ceiling and bushed on both ends. Low-voltage installer shall determine exact locations and quantities.

C. Cable Support: NRTL labeled for support of Category 6 cabling, designed to prevent degradation of cable performance and pinch points that could damage cable.

1. Support for cabling between the Cross-Connect the work area outlet shall be accomplished with metal j-hooks. Plenum rated plastic Velcro straps, zip-ties, etc... will not be allowed.

2.02 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mohawk - GigaLAN Category 6E
2. Superior Essex - NextGain Category 6eX
3. Berk-Tek - LANmark-2000 Premium Cat 6
4. Siemon – Premium 6 UTP Cable
5. Systimax – Gigaspeed XL Cat 6
6. General – Enhanced Cat 6

B. Description: Enhanced Category 6, 100-ohm, 23 AWG 4-pair UTP, with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-C.2 for performance specifications.
3. Comply with TIA/EIA-568-C.2, Category 6.
4. Shall meet IEEE 802.af and IEEE 802at for PoE applications

5. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

a. Communications, Plenum Rated: Type CMP, complying with NFPA 262.

2.03 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Panduit Corp. - TX6000 series
2. Belden – Cat 6+
3. Siemon – Z-Max Cat 6
4. Systimax – GigaSpeed XL Cat 6.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Terminate all cables in rack-mounted patch panels. Do not install wall-mounted blocks.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

1. Number of Terminals per Field: One for each conductor in assigned cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables. Provide (48) port panels with 25% spare capacity.

1. Number of Jacks per Field: One for each four-pair plus 25% spare capacity.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

G. Patch Cords: Factory-made, four-pair cables in lengths as required; terminated with eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure Category 6E performance. Patch cords shall have latch guards to protect against snagging.

2. Patch cords shall have color-coded boots for circuit identification.

2.04 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Outlets: Provide Jacks and Cables per 1.05 of this Section.

1. Metal Faceplate: Satin Stainless Steel. Coordinate with Division 26 Section "Wiring Devices."

2. For use with snap-in jacks accommodating any combination of UTP, optical fiber, and coaxial work area cords.

a. Flush mounting jacks, positioning the cord at a 45-degree angle.

3. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.05 GROUNDING

A. Comply with requirements in Division 26 Section "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with ANSI-J-STD-607-A.

2.06 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Division 26 Section "Identification for Electrical Systems."

2.07 SOURCE QUALITY CONTROL

A. Factory test UTP cables according to TIA/EIA-568-C.2.

B. Cable will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

PART 3: EXECUTION

3.01 WIRING METHODS

A. Wiring Method: Install cables in 1" minimum, metal raceways except above accessible ceiling spaces. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable only.

2. Comply with requirements for raceways and boxes specified in Division 26 Section "Raceway and Boxes for Electrical Systems."

B. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors.

C. Wiring within Enclosures: Bundle, lace, and train cables to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Provide and use lacing bars and distribution spools.

3.02 INSTALLATION OF PATHWAYS

A. Comply with requirements for demarcation point, pathways, cabinets, and racks specified in Division 27 Section "Communications Equipment Room Fittings."

B. Comply with TIA/EIA-569-A for pull-box sizing and length of conduit and number of bends between pull points.

C. Comply with requirements in Division 26 Section "Raceway and Boxes for Electrical Systems" for installation of conduits and wireways.

D. Install manufactured conduit sweeps and long-radius elbows whenever possible.

E. Pathway Installation in Communications Equipment Rooms:

1. Position conduit ends adjacent to a corner on backboard where a single piece of plywood is installed, or in the corner of room where multiple sheets of plywood are installed around perimeter walls of room. Where applicable, conduits shall enter room at a location to correspond with ladder racking in room.

2. Secure conduits to backboard when entering room from overhead.

3. Extend conduits 4 inches above finished floor.

4. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.

3.03 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.

2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."

3. Terminate conductors; no cable shall contain un-terminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.

4. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.

5. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

6. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.

7. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.

8. Cold-Weather Installation: Bring cable to room temperature before de-reeling. Heat lamps shall not be used for heating.

9. In the communications equipment room, install a 10-foot-long service loop on each end of cable.

10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.

2. Do not untwist UTP cables more than 1/2 inch from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.

2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 60 inches apart.

3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA/EIA-569-A for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.

2. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches.

3. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.04 FIRESTOPPING

A. Comply with requirements in Division 07 Section "Penetration Firestopping."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

D. Use firestopping pillows only. Do not use fire caulk.

3.05 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

1. Administration Class: 2.

2. Color-code cross-connect fields. Apply colors to voice and data service backboards, connections, covers, and labels.

B. Paint and label colors for equipment identification shall comply with TIA/EIA-606-A for Class 2 level of administration.

C. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

D. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, backbone pathways and cables, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

E. Cable and Wire Identification:

1. Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

2. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

F. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.06 FIELD QUALITY CONTROL

A. Perform tests and inspection

B. Tests and Inspections:

1. Visually inspect UTP and jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.

2. Visually confirm Category 6, marking of outlets, cover plates, outlet/connectors, and patch panels.

3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

4. Test UTP backbone copper cabling for DC loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination but not cross-connection.

    a. Test instruments shall meet or exceed applicable requirements in TIA/EIA-568-B.2. Perform tests with a tester that complies with performance requirements in "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.

5. UTP Performance Tests:

    a. Test for each outlet. Perform the following tests according to TIA/EIA-568-B and TIA/EIA-568-C.2:

        1) Wire map.
        2) Length (physical vs. electrical, and length requirements).
        3) Insertion loss.
        4) Near-end crosstalk (NEXT) loss.
        5) Power sum near-end crosstalk (PSNEXT) loss.
        6) Equal-level far-end crosstalk (ELFEXT).
        7) Power sum equal-level far-end crosstalk (PSELFEXT).
        8) Return loss.
        9) Propagation delay.
        10) Delay skew.

6. Final Verification Tests: Perform verification tests for UTP systems after the complete communications cabling and workstation outlet/connectors are installed.

    a. Voice Tests: These tests assume that dial tone service has been installed. Connect to the network interface device at the demarcation point. Go off-hook and listen and receive a dial tone. If a test number is available, make and receive a local, long distance, and digital subscription line telephone call.

    b. Data Tests: These tests assume the Information Technology Staff has a network installed and is available to assist with testing. Connect to the network interface device at the demarcation point. Log onto the network to ensure proper connection to the network.

C. Document data for each measurement. Data for submittals shall be printed in a summary report that is formatted in accordance with the BICSI TDMM, or transferred from the instrument to the computer, saved as text files, and printed and submitted.

D. End-to-end cabling will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.07 DEMONSTRATION

A. Train Owner's maintenance personnel in cable-plant management operations, including changing signal pathways for different workstations, rerouting signals in failed cables, and keeping records of cabling assignments and revisions when extending wiring to establish new workstation outlets.

END OF SECTION 27 1500

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SECTION 280513

CONDUCTORS AND CABLES FOR ELECTRONIC SAFETY AND SECURITY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Fire alarm wire and cable.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.

D. Open Cabling: Passing telecommunications cabling through open space (e.g., between the studs of a wall cavity).

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

B. 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.

2.2 FIRE ALARM WIRE AND CABLE

A. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

B. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.

1. Circuit Integrity Cable: Twisted shielded pair, NFPA 70, Article 760, Classification CI, for power-limited fire alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.

C. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
3. Multiconductor Armored Cable: NFPA 70, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NTRL listed for fire alarm and cable tray installation, plenum rated.

PART 3 - EXECUTION

3.1 INSTALLATION OF HANGERS AND SUPPORTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for installation of supports for cables.

3.2 FIRE ALARM WIRING INSTALLATION

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 260533

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Fire alarm circuits and equipment control wiring associated with the fire alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

C. Wiring Method:

1. Cables and pathways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.
2. Fire-Rated Cables: Use of two-hour, fire-rated fire alarm cables, NFPA 70, Types MI and CI, is not permitted.
3. Signaling Line Circuits: Power-limited fire alarm cables shall not be installed in the same cable or pathway as signaling line circuits.

D. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

E. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

F. Color Coding: Color code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm circuit wiring and another for supervisory circuits. Color code audible alarm-

indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.3 CONNECTIONS

A. Comply with requirements in Section 283111 "Digital, Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.4 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-C, "Firestopping" Annex A.

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA-606-B. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

END OF SECTION 280513

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SECTION 283111

ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Contractor is responsible for the installation of the system (devices, conduit and junction boxes, wiring, etc.). After installation by the Contractor, the Owner's vendor (Floyd Total Security) will install a cell-dialer to enable the alarm system to be monitored.

B. Section Includes:

1. Fire-alarm control unit.
2. Manual fire-alarm boxes.
3. System smoke detectors.
4. Heat detectors.
5. Notification appliances.
6. Device guards.
7. Addressable interface device.
8. Digital alarm communicator transmitter.
9. Radio alarm transmitter.
10. Network communications.

C. Related Requirements:

1. Section 280513 "Conductors and Cables for Electronic Safety and Security" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

A. EMT: Electrical Metallic Tubing.

B. FACP: Fire Alarm Control Panel.

C. HLI: High Level Interface.

D. NICET: National Institute for Certification in Engineering Technologies.

E. PC: Personal computer.

F. VESDA: Very Early Smoke-Detection Apparatus.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.

1. Include construction details, material descriptions, dimensions, profiles, and finishes.
2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.

1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
2. Include plans, elevations, sections, details, and attachments to other work.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
11. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:
    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified, fire-alarm technician; Level III minimum.
    c. Licensed or certified by authorities having jurisdiction.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
    a. Comply with the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
    b. Provide "Fire Alarm and Emergency Communications System Record of Completion Documents" according to the "Completion Documents" Article in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    c. Complete wiring diagrams showing connections between all devices and equipment. Each conductor shall be numbered at every junction point with indication of origination and termination points.

d. Riser diagram.
e. Device addresses.
f. Record copy of site-specific software.
g. Provide "Inspection and Testing Form" according to the "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:

1) Equipment tested.
2) Frequency of testing of installed components.
3) Frequency of inspection of installed components.
4) Requirements and recommendations related to results of maintenance.
5) Manufacturer's user training manuals.

h. Manufacturer's required maintenance related to system warranty requirements.
i. Abbreviated operating instructions for mounting at fire-alarm control unit and each annunciator unit.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.6 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. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
5. Keys and Tools: One extra set for access to locked or tamperproofed components.
6. Audible and Visual Notification Appliances: One of each type installed.
7. Fuses: Two of each type installed in the system. Provide in a box or cabinet with compartments marked with fuse types and sizes.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

1.8 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail in materials or workmanship within specified warranty period.

1. Warranty Extent: All equipment and components not covered in the Maintenance Service Agreement.
2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Source Limitations for Fire-Alarm System and Components: Components shall be compatible with, and operate as an extension of, existing system. Provide system manufacturer's certification that all components provided have been tested as, and will operate as, a system.

B. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.

C. Automatic sensitivity control of certain smoke detectors.

D. All components provided shall be listed for use with the selected system.

E. 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.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.

B. Fire-alarm signal shall initiate the following actions:

1. Continuously operate alarm notification appliances.
2. Identify alarm and specific initiating device at fire-alarm control unit.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Activate voice/alarm communication system.
7. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
8. Activate emergency shutoffs for gas and fuel supplies.
9. Record events in the system memory.

C. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.

3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
4. Loss of primary power at fire-alarm control unit.
5. Ground or a single break in internal circuits of fire-alarm control unit.
6. Abnormal ac voltage at fire-alarm control unit.
7. Break in standby battery circuitry.
8. Failure of battery charging.
9. Abnormal position of any switch at fire-alarm control unit or annunciator.

D. System Supervisory Signal Actions:

1. Initiate notification appliances.
2. Identify specific device initiating the event at fire-alarm control unit.
3. Record the event on system printer.
4. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
5. Transmit system status to building management system.
6. Display system status on graphic annunciator.

2.3 FIRE-ALARM CONTROL UNIT

A. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; AFC-50 50-Point Addressable Fire Alarm Control Panel or a comparable product by one of the following:

1. Notifier.
2. Silent Knight.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.

    a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
    b. Include a real-time clock for time annotation of events on the event recorder and printer.
    c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
    d. The FACP shall be listed for connection to a central-station signaling system service.
    e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.
3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands.
3.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class A or Class B

E. Notification-Appliance Circuit:

1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

F. Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and print out the final adjusted values on system printer.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify zone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from all other printed indications. Also print system reset event, including same information for device, location, date, and time. Commands initiate the printing of a list of existing alarm, supervisory, and trouble conditions in the system and a historical log of events.

I. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals and digital alarm radio transmitters shall be powered by 24-V dc source.

1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

J. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

1. Batteries: Vented, wet-cell pocket, plate nickel cadmium.

K. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC ; PAD100-PSSA-PSDA Addressable Pull Station Single/Dual Action. or a comparable product by one of the following:

1. Or, approved equal.

B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.5 SYSTEM SMOKE DETECTORS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be [**four**] [**two**]-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type, indicating detector has operated[**and power-on status**].
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition[**and individually adjustable for sensitivity by fire-alarm control unit**].

    a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
    b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
    c. Multiple levels of detection sensitivity for each sensor.
    d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

2.6 HEAT DETECTORS

A. <Double click here to find, evaluate, and insert list of manufacturers and products.>

B. General Requirements for Heat Detectors: Comply with UL 521.

1. Temperature sensors shall test for and communicate the sensitivity range of the device.

C. Heat Detector, Combination Type: Actuated by either a fixed temperature of [**135 deg F**] <**Insert temperature**> or a rate of rise that exceeds [**15 deg F**] <**Insert temperature**> per minute unless otherwise indicated.

1. Mounting: [**Adapter plate for outlet box mounting**] [**Twist-lock base interchangeable with smoke-detector bases**].
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

D. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of [**190 deg F**] <**Insert temperature**>.

1. Mounting: [**Adapter plate for outlet box mounting**] [**Twist-lock base interchangeable with smoke-detector bases**].
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

E. Continuous Linear Heat-Detector System:

1. Detector Cable: Rated detection temperature [**155 deg F**] <**Insert temperature**>. Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
2. Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
3. Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
4. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.7 NOTIFICATION APPLIANCES

A. Basis-of-Design Product: Subject to compliance with requirements, provide Potter Electric Signal Company, LLC; CS/CHS Series Selectable Candela Ceiling Mount Horn/Strobe or a comparable product by one of the following:

1. Or, Approved equal.

B. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

C. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

D. Visible Notification Appliances: Xenon strobe lights complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch-high letters on the lens.

1. Rated Light Output:
   a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Ceiling mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, white.

2.8 ADDRESSABLE INTERFACE DEVICE

A. General:

1. Include address-setting means on the module.
2. Store an internal identifying code for control panel use to identify the module type.
3. Listed for controlling HVAC fan motor controllers.

B. Monitor Module: Microelectronic module providing a system address for alarm-initiating devices for wired applications with normally open contacts.

C. Integral Relay: Capable of providing a direct signal to circuit-breaker shunt trip for power shutdown.

1. Allow the control panel to switch the relay contacts on command.
2. Have a minimum of two normally open and two normally closed contacts available for field wiring.

2.9 CEILLULAR ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be provided by Owner’s Vendor (Floyd Total Security)

2.10 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by device manufacturer.
2. Finish: Paint of color to match the protected device.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.

1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."

1. Devices placed in service before all other trades have completed cleanup shall be replaced.
2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.

B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:

1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
2. Mount manual fire-alarm box on a background of a contrasting color.
3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:

1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
3. Smooth ceiling spacing shall not exceed 30 feet.
4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.

1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

H. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

I. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.3 PATHWAYS

A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.

1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.

B. Pathways shall be installed in EMT.

C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
1. Electronically locked doors and access gates.
2. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL

A. Field tests shall be witnessed by authorities having jurisdiction.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

D. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.

    a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
    b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Test audible appliances for the private operating mode according to manufacturer's written instructions.
4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

E. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

F. Fire-alarm system will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports.

H. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

I. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.9 SOFTWARE SERVICE AGREEMENT

A. Comply with UL 864.

B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.

C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two 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 access to system and to upgrade computer equipment if necessary.

3.10 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION 283111

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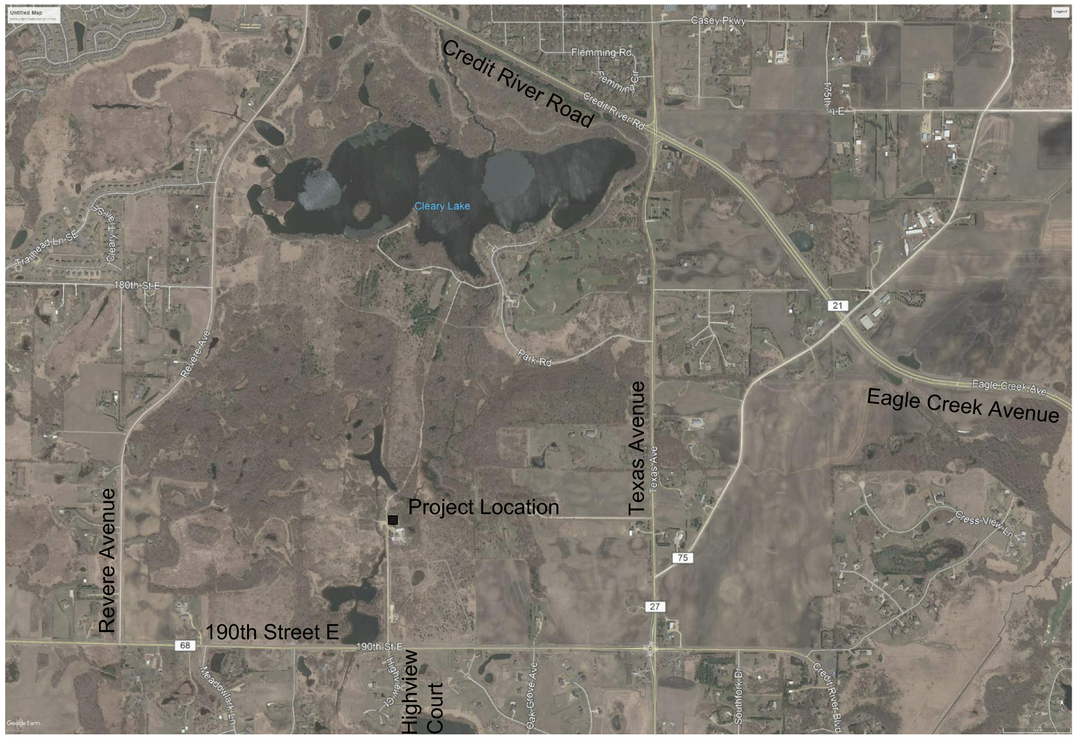
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG



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CIVIL ENGINEER:

SFR CONSULTING GROUP
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ST. PAUL, MINNESOTA 55114
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(866) 440.6364 fax

STRUCTURAL ENGINEER:

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510 MARQUETTE AVENUE SOUTH, SUITE 900
MINNEAPOLIS, MN 55402
(651) 338.0713

MECHANICAL ENGINEER

PAULSON & CLARK ENGINEERING
2352 COUNTY ROAD J
WHITE BEAR LAKE, MN 55110
(651) 407.6056

ELECTRICAL ENGINEER:

PAULSON & CLARK ENGINEERING
2352 COUNTY ROAD J
WHITE BEAR LAKE, MN 55110
(651) 407.6056

APPLICABLE CODES:

2015 MN STATE BLDG. CODE
2015 MN STATE FIRE CODE
2015 MN STATE ACCESSIBILITY CODE

OCCUPANCY:

B OFFICE
S-1 VEHICLE MAINTENANCE / STORAGE

CONSTRUCTION TYPE:

1. TYPE V-B
2. NO AUTOMATIC FIRE SUPPRESSION

FIRE-RESISTIVITY:

IBC TABLE 601 FOR TYPE V-B

STRUCTURAL FRAME	0	FIRE RATING
EXTERIOR BEARING WALLS	0	FIRE RATING
INTERIOR BEARING WALLS	0	FIRE RATING
EXTERIOR NONBEARING WALLS	0	FIRE RATING
INTERIOR NONBEARING WALLS	0	FIRE RATING
FLOOR CONSTRUCTION	0	FIRE RATING
ROOF CONSTRUCTION	0	FIRE RATING

IBC TABLE 602 FOR TYPE V-B, GROUP S-1

EXTERIOR WALLS	0	BUILDING IS GREATER THAN 10' FROM ALL PROPERTY LINES

IBC TABLE 508.4 SEPARATION OF OCCUPANCIES
B AND S-1 = NO SEPARATION REQUIREMENT

INDEX:

PLUMBING FIXTURES

VEHICLE MAINTENANCE = 5,895 S.F. / 200 PER OCCUPANT = 29.5 OCCUPANTS

0.295 WATER CLOSETS
0.295 LAVS
.003 DRINKING FOUNTAINS
1 SERVICE SINK

OFFICE = 2,960 S.F. / 100 PER OCCUPANT = 29.6 OCCUPANTS

1.18 WATER CLOSETS
.74 LAVS
.297 DRINKING FOUNTAINS
1 SERVICE SINK

TOTALS NEEDED	TOTALS PROVIDED
1.475 WATER CLOSETS	2WATER CLOSETS
1.035 LAVS	2 LAVS
.300 DRINKING FOUNTAINS	1 DRINKING FOUNTAINS
2 SERVICE SINKS	2 SERVICE SINKS

ALLOWABLE SQUARE FOOTAGE

ALLOWABLE		PROPOSED	
S-1	9,000 S.F.	S-1	4,720 S.F.
S-1	9,000 S.F.	S-1	1,175 S.F. (mezz)
B	9,000 S.F.	B	2,960 S.F.
		TOTAL	8,855 S.F.

COMMON PATH OF EGRESS TRAVEL
B&S = 100' (less than 30 occupants) - ALLOWABLE
PROVIDED: 96' FROM MEZZANINE

EXIT ACCESS TRAVEL DISTANCE PER 1016.2
B = 200' UNSPRINKLERED - ALLOWABLE
S-1 = 200' UNSPRINKLERED - ALLOWABLE
PROVIDED: 98' longest path

RECYCLING SPACE

OFFICE	.0025 * 2,960 = 7.4 s.f.
GARAGE	.001 * 4,720 = 4.72 s.f.
WAREHOUSE	.001 * 980 = .98 s.f.
MECHANICAL	.001 * 195 = .195 s.f.
TOTAL REQUIRED	13.295 s.f. min.

PROVIDED: 14 s.f.

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ThreeRivers PARK DISTRICT
in partnership with
Scott County

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REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

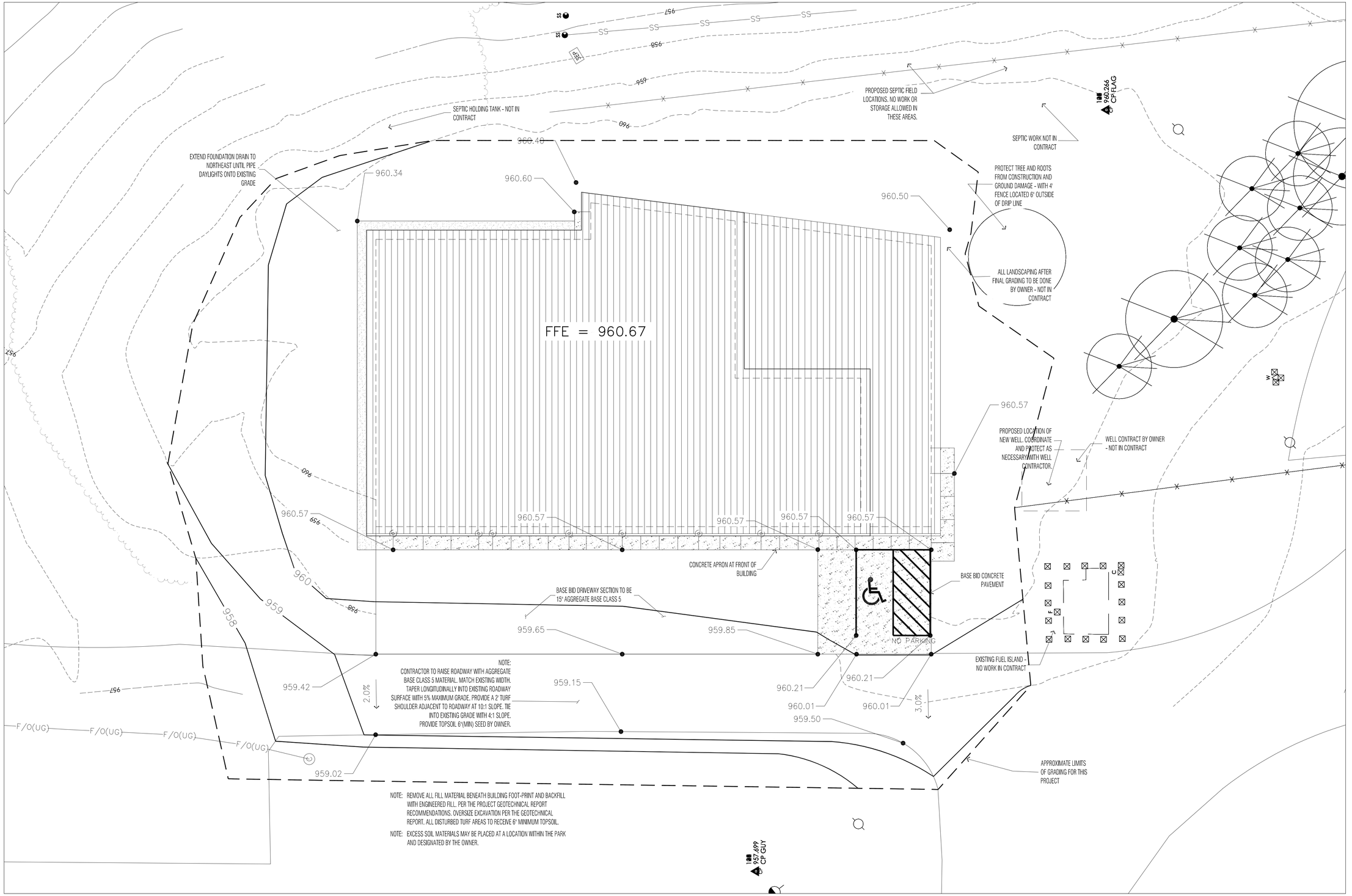
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA

Signature
Jeffery L. Oertel
Name
15840 License #
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RAB
CHECKED BY: JLO

SHEET NAME:
TITLE

SHEET NO:
T



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in partnership with

Scott County

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REVISIONS / ISSUE

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Prior Lake, MN 55372

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Signature

MICHAEL C. AARON
Name

25721 License #

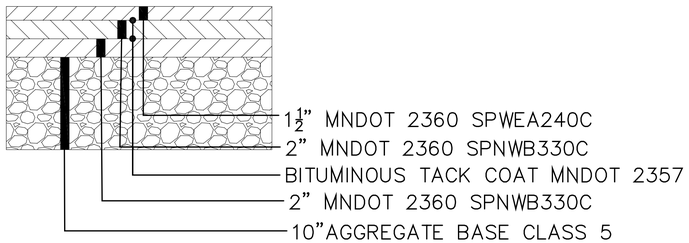
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: NWS
CHECKED BY: MCA
SHEET NAME:

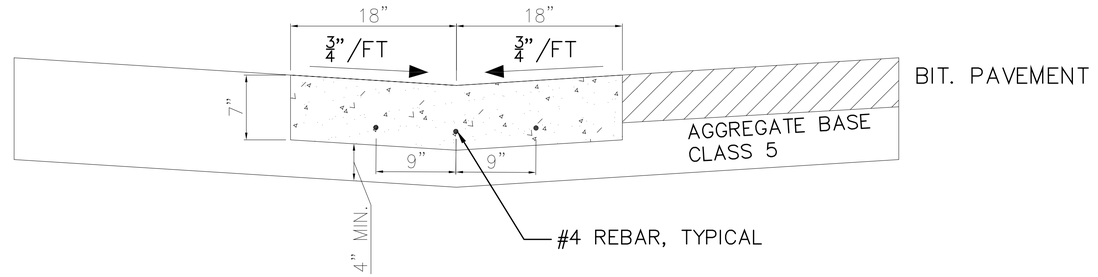
GRADING PLAN

SHEET NO:

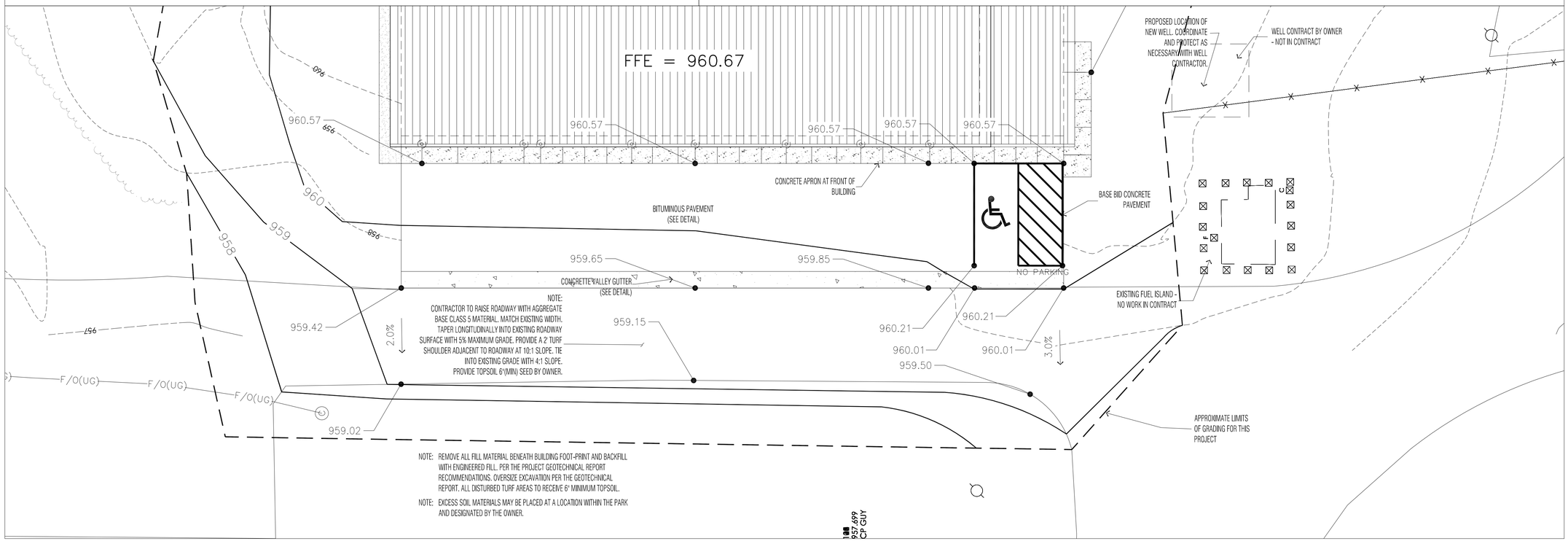
C0.1



BITUMINOUS PAVEMENT DETAIL



CONCRETE VALLEY GUTTER DETAIL



BID ALTERNATE 1

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REVISIONS / ISSUE

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Signature

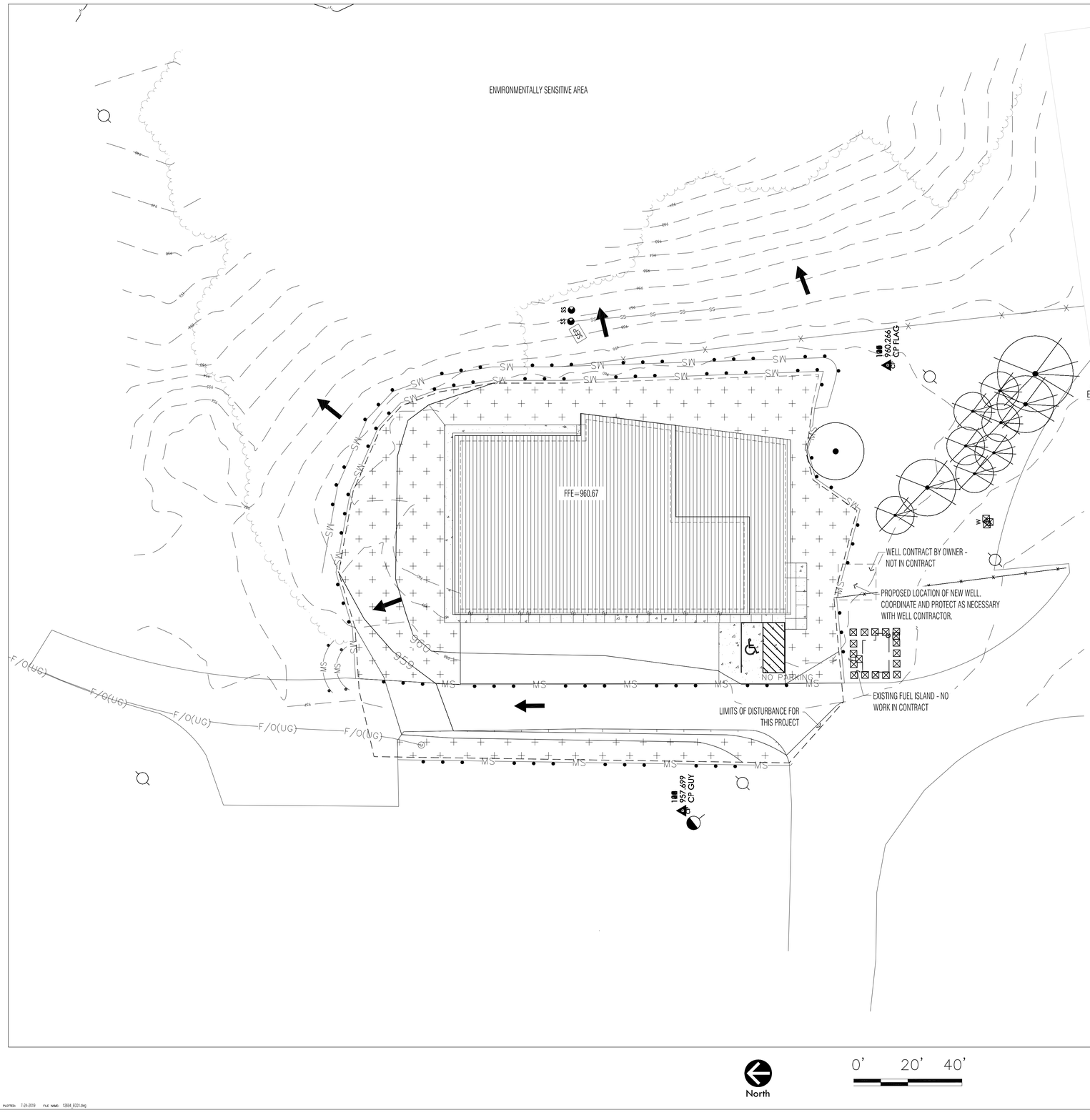
MICHAEL C. AARON
Name

25721 License #
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: NWS
CHECKED BY: MCA

SHEET NAME:
ALT. 1 & DETAILS

SHEET NO:
C0.2



EROSION CONTROL AND TURF ESTABLISHMENT NOTES

1. THE CONTRACTOR SHALL COMPLY WITH THE REQUIREMENTS REGARDING POLLUTION PREVENTION MANAGEMENT DURING CONSTRUCTION, WHICH SHALL INCLUDE, BUT NOT BE LIMITED TO, PROVIDING THE FOLLOWING (ITEMS LISTED ARE INCIDENTAL):
   - A. WASHOUT AREAS FOR CONCRETE, STUCCO, PAINT, FORM RELEASE OIL, CURING COMPOUNDS AND OTHER CONSTRUCTION MATERIALS FOR USE BY ALL SUBCONTRACTORS AND MATERIAL TESTING PERSONNEL. LOCATION OF EXISTING WASHOUT AREAS SHALL BE IDENTIFIED BY SIGNAGE AND SHALL BE AT LEAST 200 FT FROM SITE MANAGEMENT PLAN REQUIREMENT AREAS (IF APPLICABLE) OR ENVIRONMENTALLY SENSITIVE AREAS, AND UTILIZE A LEAK-PROOF CONTAINMENT FACILITY OR IMPERMEABLE LINER THAT PREVENTS RUNOFF ONTO ADJACENT SOILS. AN ENGINEERED COLLECTION SYSTEM CAN ALSO BE USED IF IT IS APPROVED BY THE PROJECT ENGINEER.
   - B. THE CONTRACTOR SHALL OBTAIN APPROVAL FROM THE PROJECT ENGINEER FOR A CHEMICAL STORAGE AREA AND SHALL DESIGNATE AN AREA FOR FUELING AND MINOR MAINTENANCE OF CONSTRUCTION VEHICLES (INCLUDING WASHING) WITH MEANS TO CAPTURE ANY FUEL SPILLS. RUNOFF SHALL BE CONTAINED IN A TEMPORARY SEDIMENT BASIN OR OTHER EFFECTIVE CONTROL AND ALL WASTE GENERATED SHALL BE PROPERLY DISPOSED OF. NO ENGINE DEGREASING IS ALLOWED ON SITE.
   - C. SOLID WASTE COLLECTION AND REMOVAL
   - D. SECONDARY CONTAINMENT FOR STORAGE OF HAZARDOUS MATERIALS
   - E. SECURED HAZARDOUS WASTE STORAGE CONTAINERS
   - F. CHEMICAL SPILL KITS (SHALL BE PROVIDED AT EACH LOCATION WHERE CHEMICALS ARE USED OR STORED AND ANY LOCATION WHERE VEHICLES ARE FUELED OR MAINTAINED).
   - G. PORTABLE RESTROOM FACILITIES THAT ARE ANCHORED TO PREVENT TIPPING.
2. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CREATING AND FOLLOWING A WRITTEN DISPOSAL PLAN FOR ALL HAZARDOUS WASTE MATERIALS. THE PLAN SHALL INCLUDE HOW THE MATERIAL SHALL BE DISPOSED OF AND THE LOCATION OF THE DISPOSAL SITE AND SHALL BE SUBMITTED TO THE ENGINEER PRIOR TO WORK ON SITE. LEAKS, SPILLS, OR OTHER RELEASES SHALL BE RESPONDED TO IN ACCORDANCE WITH MPCA SPILL CONTAINMENT AND REMEDIAL ACTION PROCEDURES.
3. THE EROSION PREVENTION AND SEDIMENT CONTROL BMPS SHALL BE PLACED AS NECESSARY TO MINIMIZE EROSION FROM DISTURBED SURFACES AND CAPTURE SEDIMENT ONSITE. ALL EROSION CONTROL MEASURES SHALL BE IN PLACE PRIOR TO ANY REMOVAL WORK AND/OR GROUND DISTURBING ACTIVITIES AND SHALL BE MAINTAINED UNTIL THE POTENTIAL FOR EROSION HAS BEEN ELIMINATED. IF SEDIMENT CONTROLS ARE OVERLOADED (BASED ON FREQUENT FAILURE OR EXCESSIVE MAINTENANCE), ADDITIONAL UPGRADIENT OR REDUNDANT BMPS SHALL BE PLACED.
4. SEDIMENT CONTROL DEVICES SHALL BE ESTABLISHED ON ALL DOWN GRADIENT PERIMETERS BEFORE ANY UP GRADIENT LAND DISTURBING ACTIVITIES BEGIN. SEDIMENT CONTROL DEVICES INCLUDE, BUT ARE NOT LIMITED TO THE FOLLOWING:
   - A. PERIMETER CONTROL SHALL BE LOCATED ON THE CONTOUR TO CAPTURE OVERLAND, LOW-VELOCITY SHEET FLOWS DOWN GRADIENT OF ALL EXPOSED SOILS AND PRIOR TO DISCHARGING TO SURFACE WATERS. THE BMP SHALL BE J-HOOKED AT A MAXIMUM OF 100 FOOT INTERVALS AND EACH SECTION SHALL CONTAIN NO MORE THAN 1/4 ACRE OF DRAINAGE AREA.
5. PRESERVE A NATURAL BUFFER OF AT LEAST 50 FEET (100 FEET IF WITHIN 1 MILE OF AND DRAINS TO A SPECIAL OR IMPAIRED WATER) BETWEEN DISTURBED AREAS AND FLOWS TO A SURFACE WATER (NOT REQUIRED AT DITCHES OR STORMWATER CONVEYANCE CHANNELS, STORM DRAIN INLETS OR SEDIMENT BASINS). IF A BUFFER IS INFEASIBLE, PROVIDE AS LARGE A BUFFER AS POSSIBLE AND REDUNDANT SEDIMENT CONTROLS.
6. DITCHES AND EXPOSED SOILS SHALL BE KEPT IN AN EVEN ROUGH GRADED CONDITION IN ORDER TO BE ABLE TO APPLY EROSION CONTROL MULCHES AND BLANKETS.
7. INITIATE STABILIZATION OF ALL EXPOSED SOIL AND STOCKPILE AREAS IMMEDIATELY AFTER CONSTRUCTION ACTIVITY ON THAT PORTION OF THE SITE HAS TEMPORARILY OR PERMANENTLY CEASED. TEMPORARY OR PERMANENT STABILIZATION SHALL BE COMPLETED WITHIN NO MORE THAN 7 DAYS. ALL EXPOSED SOIL WITHIN 200 LINEAL FEET OF AND DRAINING TO A PUBLIC WATER WITH "WORK IN WATER RESTRICTIONS" AND DURING SPECIFIED FISH SPAWNING TIME FRAMES, SHALL BE STABILIZED WITHIN 24 HOURS. IN MANY INSTANCES, THIS SHALL REQUIRE STABILIZATION TO OCCUR MORE THAN ONCE DURING ROUGH GRADING. MNDOT RAPID STABILIZATION METHOD 3 SHALL BE USED TO PROVIDE TEMPORARY COVER IN THESE AREAS AS APPROPRIATE. SUBSTITUTE MNDOT SEED MIXTURE 21-112 OR 21-111 FOR THE SPECIFIED SEED MIXTURE AS APPROPRIATE FOR THE SEASON.
8. ALL EXPOSED SOIL AREAS SHALL BE STABILIZED PRIOR TO THE ONSET OF WINTER. ANY WORK STILL BEING PERFORMED SHALL BE SNOW MULCHED, SEEDED, OR BLANKETED.
9. ALL TOPSOIL BERMS SHALL BE STABILIZED AS FOLLOWS:
   - A. BETWEEN APRIL 1 - AUGUST 31, SEED WITH MNDOT SEED MIXTURE 21-111
   - B. BETWEEN SEPTEMBER 1 AND MARCH 31, SEED WITH MNDOT SEED MIXTURE 21-112 AND TOP WITH MNDOT RAPID STABILIZATION 2.

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SRF Consulting Group, Inc. ENGINEERS PLANNERS DESIGNERS
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MINNEAPOLIS, MN. 55447
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REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature

ERIC D. ROERISH
Name

45645 License # | 07/25/19 Date

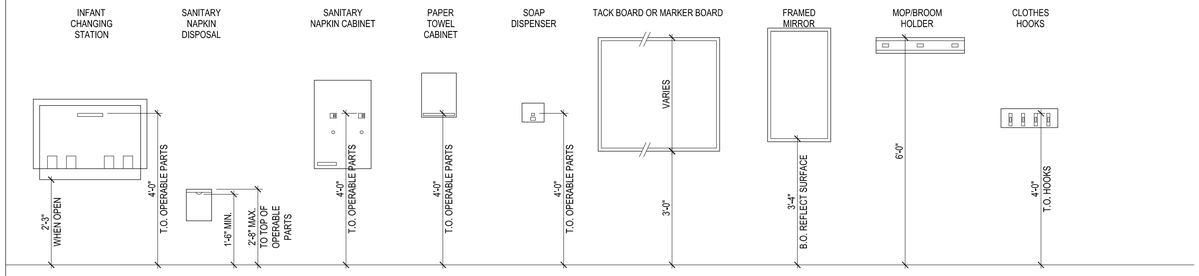
PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: AET
CHECKED BY: EDR

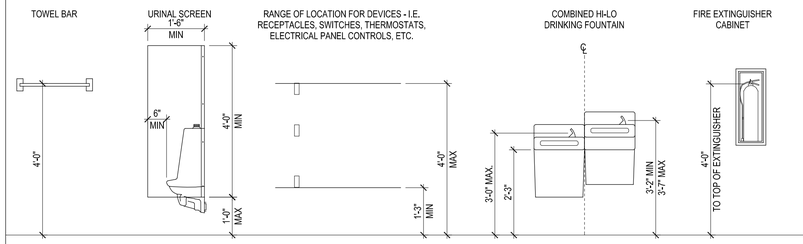
SHEET NAME:
EROSION CONTROL AND TURF ESTABLISHMENT PLAN

SHEET NO:
C0.3

PLOTTED: 7-24-2019 FILE NAME: 12934_E201.dwg

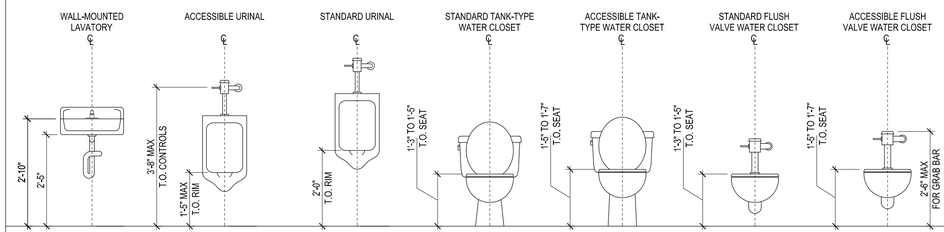
MOUNTING HEIGHTS





NOTES:

1. FOR ACCESSORIES MOUNTED ABOVE A COUNTER, THE TOP OF OPERABLE PARTS TO BE NO HIGHER THAN 3'-8" A.F.F.
2. SURFACE MOUNTED ACCESSORIES WITH A 4" OR GREATER PROJECTION FROM THE WALL MUST BE MOUNTED IN AN ALCOVE, OVER A COUNTER, OR WITH THE BOTTOM EDGE NO HIGHER THAN 2'-3" A.F.F.
3. PROVIDE AT LEAST 2" CLEARANCE BETWEEN THE TOP OF AN ACCESSORY AND THE BOTTOM OF THE GRAB BAR. PROVIDE AT LEAST 1'-0" CLEARANCE BETWEEN THE BOTTOM OF AN ACCESSORY AND THE TOP OF A GRAB BAR. DOES NOT APPLY TO FULLY RECESSED ACCESSORIES.
4. FOR ACCESSORIES NOT INDICATED OR DIFFERING SUBSTANTIALLY FROM THE DIAGRAMS, CONSULT THE ARCHITECT PRIOR TO INSTALLATION OF BLOCKING/ BACKING.
5. PLUMBING FIXTURES SHOWN ARE DIAGRAMMATIC. SEE PLUMBING FOR SPECIFICATIONS.
6. ALL DIMENSIONS ARE TO FINISHED SURFACE.



ABBREVIATIONS

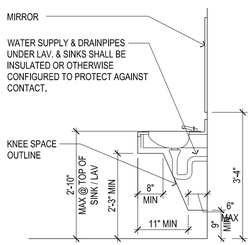
ABV	ABOVE
ACT	ACOUSTICAL CEILING TILE
ADJ	ADJACENT
AFF	ABOVE FINISH FLOOR
ALT	ALTERNATE
APPROX	APPROXIMATE
ARCH	ARCHITECT / ARCHITECTURAL
BD	BOARD
BO	BOTTOM OF
BOT	BOTTOM
CIP	CAST IN PLACE
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CONST	CONSTRUCTION
CONT	CONTINUOUS
CPT	CARPET
DEMO	DEMOLISH
DF	DRINKING FOUNTAIN
DIV	DIVIDE/DIVISION
DWG	DRAWING
EA	EACH
EIFS	EXTERIOR INSULATED FINISH SYSTEM
ELEC	ELECTRIC / ELECTRICAL
ENG	ENGINEER
EQP	EQUIPMENT
FDC	FIRE DEPARTMENT CONNECTION
FF	FINISH FLOOR
FFE	FINISH FLOOR ELEVATION
FIN	FINISH/FINISHED
FO	FACE OF
FRP	FIBER REINFORCED PANEL
GA	GAUGE
GYP	GYPSUM
GYP BD	GYPSUM BOARD
HDW	HARDWARE
HDWD	HARDWOOD
ID	INSIDE DIAMETER / DIMENSION
INSUL	INSULATION / INSULATED
INT	INTERIOR
LAV	LAVATORY
MAX	MAXIMUM
MDF	MEDIUM DENSITY FIBERBOARD
MECH	MECHANICAL
MIN	MINIMUM
MIR	MIRROR
NA	NOT APPLICABLE
NIC	NOT IN CONTRACT
NOM	NOMINAL
OA	OVERALL
OC	ON CENTER
OD	OUTSIDE DIAMETER
OH	OVERHEAD
OPP	OPPOSITE
PNT	PAINT
PREFIN	PREFINISHED
PLAM	PLASTIC LAMINATE
PLYWD	PLYWOOD
PREFAB	PREFABRICATED
QTY	QUANTITY
RB	RUBBER BASE
RCP	REFLECTED CEILING PLAN
REF	REFER
REQ	REQUIRED
REV	REVISION/REVISE
RM	ROOM
RO	ROUGH OPENING
SCHED	SCHEDULE
SF	SQUARE FEET
SHT	SHEET
SHTG	SHEATHING
SIM	SIMILAR
SPEC	SPECIFICATION
SQ	SQUARE
STC	SOUND TRANSMISSION CLASS
STD	STANDARD
STRUCT	STRUCTURE / STRUCTURAL
T&G	TONGUE AND GROOVE
TEMP	TEMPORARY
T.O.	TOP OF
TYP	TYPICAL
UNO	UNLESS OTHERWISE NOTED
VB	VINYL BASE
VCT	VINYL COMPOSITE TILE
W/O	WITHOUT
WC	WATER CLOSET
WD	WOOD
WDW	WINDOW
@	AT
&	AND
℄	CENTERLINE
Ø	DIAMETER
#	NUMBER
/	PER
+/-	PLUS OR MINUS

DRAWING SYMBOL SCHEDULE

- EDIT / ATTR — ENLARGED DETAIL SYMBOL
- GRID — GRID LINE SYMBOL
- WT — WALL TYPE
- EDIT / ATTR — SECTION CUT SYMBOL
- 2 / 3 AX.X 1 / 4 — INTERIOR ELEVATION SYMBOL
- WDW — WINDOW TYPE
- 5 — KEYNOTE
- F.F.E. 100'-0" — ELEVATION SYMBOL
- EDIT / ATTR — EXTERIOR ELEVATION SYMBOL
- REV — REVISION SYMBOL

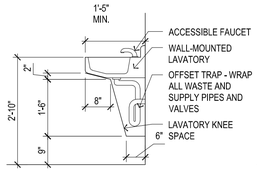
ACCESSIBLE GRAB BAR REQUIREMENTS

ACCESSIBLE VANITY TOP

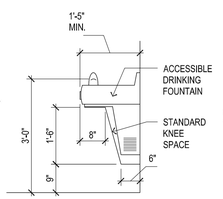


WALL-MOUNTED ACCESSIBLE LAVATORY

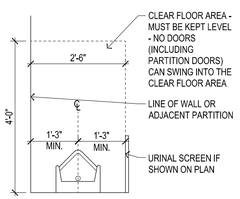
NOTE:
FOR COUNTER-SET LAVATORIES AND SINKS, SEE CASEWORK DETAILS



ACCESSIBLE DRINKING FOUNTAIN

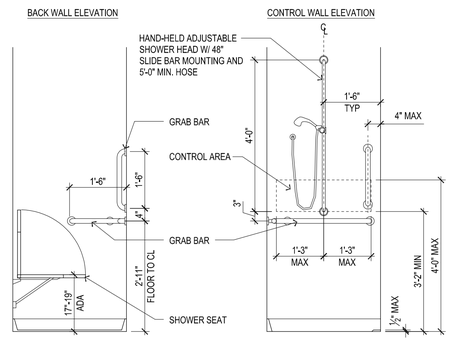


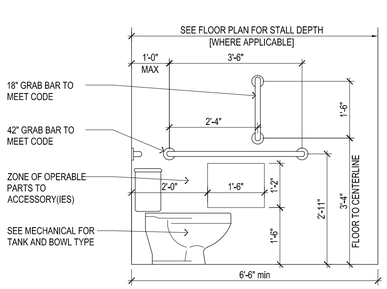
ACCESSIBLE URINAL

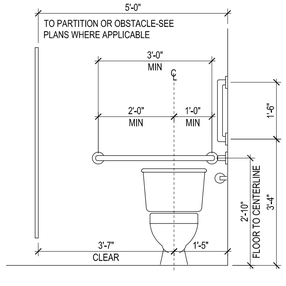


TYPICAL 5'-0" WIDE STALL MEETING ANSI-117.1 AND LOCAL CODE REQUIREMENTS WHERE APPLICABLE]

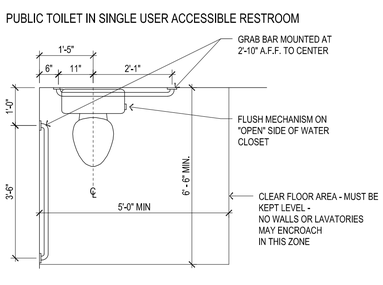
TRANSFER SHOWER ELEVATIONS



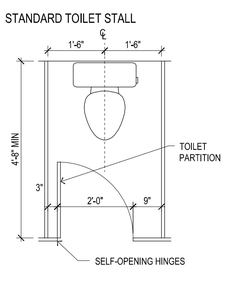




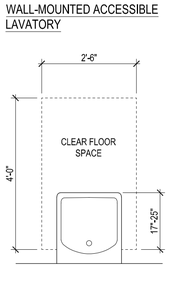
PUBLIC TOILET IN SINGLE USER ACCESSIBLE RESTROOM



STANDARD TOILET STALL



WALL-MOUNTED ACCESSIBLE LAVATORY



GENERAL NOTES

1. THE DRAWINGS AND THE SPECIFICATIONS TOGETHER REPRESENT THE CONSTRUCTION DOCUMENTS AND, AS SUCH, MUST BE USED TOGETHER AS THE BASIS OF DESIGN. THE CONTRACTOR IS SPECIFICALLY INSTRUCTED NOT TO LIMIT THEIR UNDERSTANDING OF THE SCOPE OF THIS PROJECT BASED UPON THE SPECIFICATION OR DRAWING INDEX.
2. THE CONTRACTOR IS RESPONSIBLE TO REVIEW ALL INFORMATION IN BOTH THE DRAWINGS AND THE SPECIFICATION AND IS REQUIRED TO PROVIDE ALL DEFINED, AND REASONABLY IMPLIED, SCOPE OF WORK NO MATER WHERE IT APPEARS IN THE CONSTRUCTION DOCUMENTS AS WELL AS ANY FORMALLY PROVIDED MODIFICATIONS, CLARIFICATIONS, ADDENDUMS AND/OR OTHER INFORMATION PERTAINING TO THE UNDERSTANDING OF THE SCOPE OF WORK.
3. REFER TO ALL DRAWINGS INCLUDING ARCHITECTURAL, SITE, STRUCTURAL, FIRE PROTECTION, MECHANICAL, ELECTRICAL AND PLUMBING DRAWINGS FOR ADDITIONAL GENERAL NOTES, ABBREVIATIONS AND SYMBOLS.
4. ALL DRAWINGS ARE OF EQUAL IMPORTANCE IN DEFINING THE WORK OF THE CONTRACT DOCUMENTS. CONTRACTORS SHALL REVIEW ALL DRAWINGS BEFORE THE INSTALLATION OF THEIR WORK. SHOULD THERE BE A DISCREPANCY WITHIN AND BETWEEN THE DRAWINGS THAT WOULD CAUSE AN AWKWARD OR IMPROPER INSTALLATION, NOTIFY ARCHITECT FOR CLARIFICATION PRIOR TO INSTALLATION OF SAID WORK.
5. DO NOT SCALE DRAWING. THE DRAWINGS ARE NOT NECESSARILY TO SCALE - USE GIVEN DIMENSIONS. CONTRACTORS SHALL VERIFY ALL CONDITIONS AND DIMENSIONS AT THE JOB SITE PRIOR TO THE START OF CONSTRUCTION. IF DISCREPANCIES ARE FOUND, NOTIFY ARCHITECT FOR CLARIFICATION BEFORE COMMENCING WORK.
6. ALL EXTERIOR DIMENSIONS ARE GIVEN FROM THE EXTERIOR FACE OF MASONRY WALLS. INTERIOR DIMENSIONS ARE GIVEN TO FINISH FACE OF WALL. ALL WALL AND PARTITION THICKNESS ARE NOMINAL. SEE WALL SECTIONS AND PARTITION TYPES FOR EXACT CONSTRUCTION.
7. ALL FIRE PROTECTION, MECHANICAL, ELECTRICAL AND PLUMBING PENETRATIONS THROUGH FIRE RATED CONSTRUCTION SHALL BE SLEEVED AND FIRESAFED AND/OR HAVE FIRE DAMPERS EQUIVALENT TO THE HOURLY FIRE RATING OF THE CONSTRUCTION. FIRE RATINGS WILL BE IDENTIFIED WITHIN THESE DOCUMENTS.
8. DETAILS NOT SHOWN ARE SIMILAR IN CHARACTER TO THOSE SHOWN. WHERE SPECIFIC DIMENSIONS, DETAILS OR DESIGN INTENT CANNOT BE DETERMINED, CONSULT ARCHITECT BEFORE PROCEEDING WITH THE WORK.
9. CONTRACTORS SHALL PROVIDE STIFFENERS, BRACINGS, BACKING PLATES AND SUPPORTING BRACKETS REQUIRED FOR THE PROPER INSTALLATION OF ALL CASEWORK, AND MISCELLANEOUS EQUIPMENT WHETHER SUCH SUPPORTS ARE SHOWN OR NOT.
10. INSTALL ALL RECESSED CABINETS, PANELS, BOXES LOCATED IN FIRE RATED PARTITIONS TO MAINTAIN THE FIRE RATED CONSTRUCTION.
11. GC SHALL COORDINATE ALL FIRE PROTECTION, MECHANICAL, PLUMBING AND ELECTRICAL, FLOOR, ROOF AND WALL SLEEVES AND SHAFTS WITH MECHANICAL, PLUMBING, FIRE PROTECTION, ELECTRICAL, STRUCTURAL AND ARCHITECTURAL DRAWINGS.
12. REFER TO PROJECT MANUAL AND TECHNICAL SPECIFICATION TO SUPPLEMENT THESE DRAWINGS.

PLOTTED: 7-25-2019 FILE NAME: A0.01_1842.dwg

ThreeRivers PARK DISTRICT
in partnership with
Scott County

CONSULTANT:
OERTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

REVISIONS / ISSUE

NO.	DESCRIPTION	DATE

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

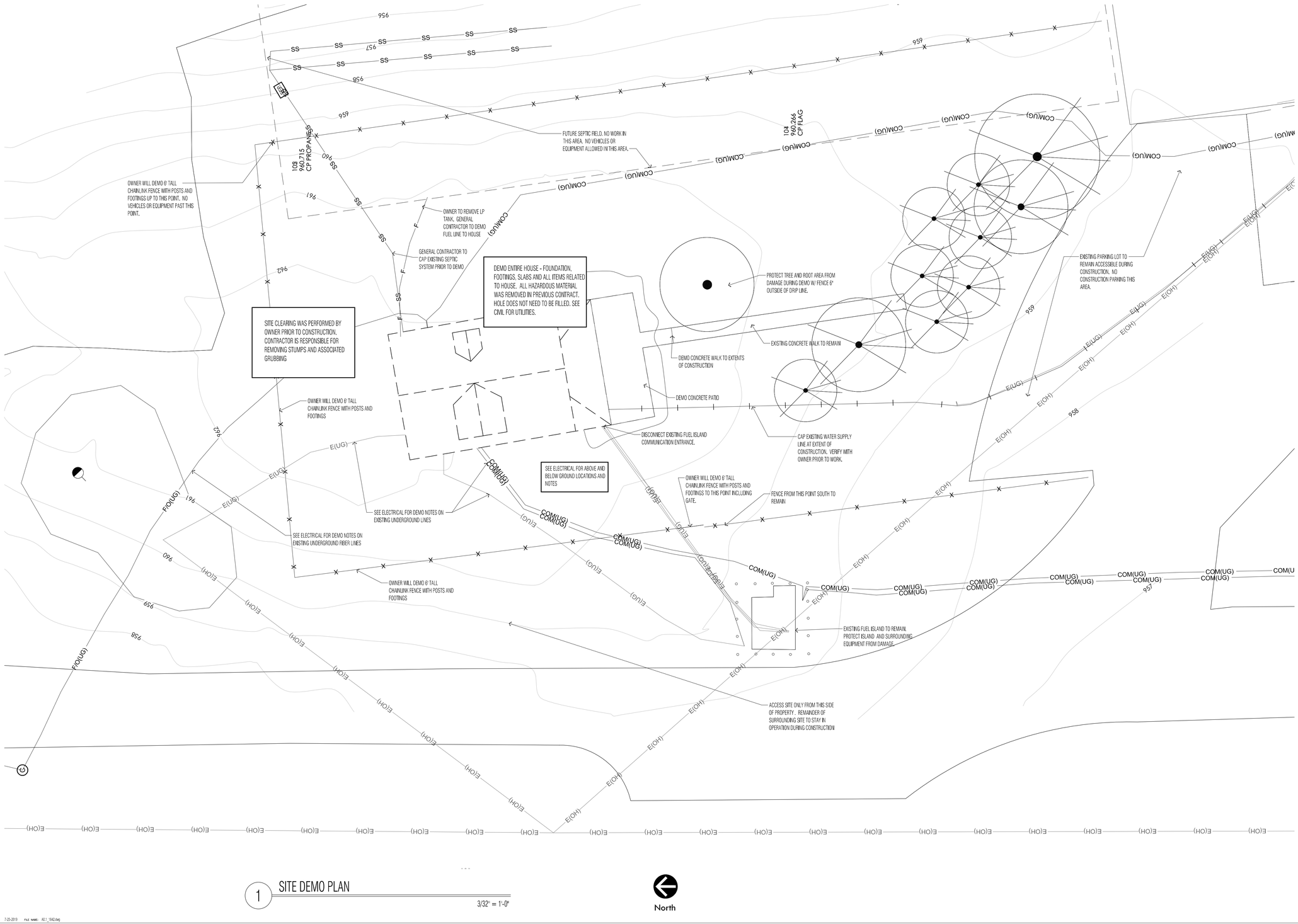
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature
Jeffery L. Oertel
Name
15840 License #
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RAB
CHECKED BY: JLO

SHEET NAME:
GENERAL INFORMATION

SHEET NO:
A0.0



1 SITE DEMO PLAN

3/32" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A0.1_1842.dwg

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Name

15840 License #

07/25/19 Date

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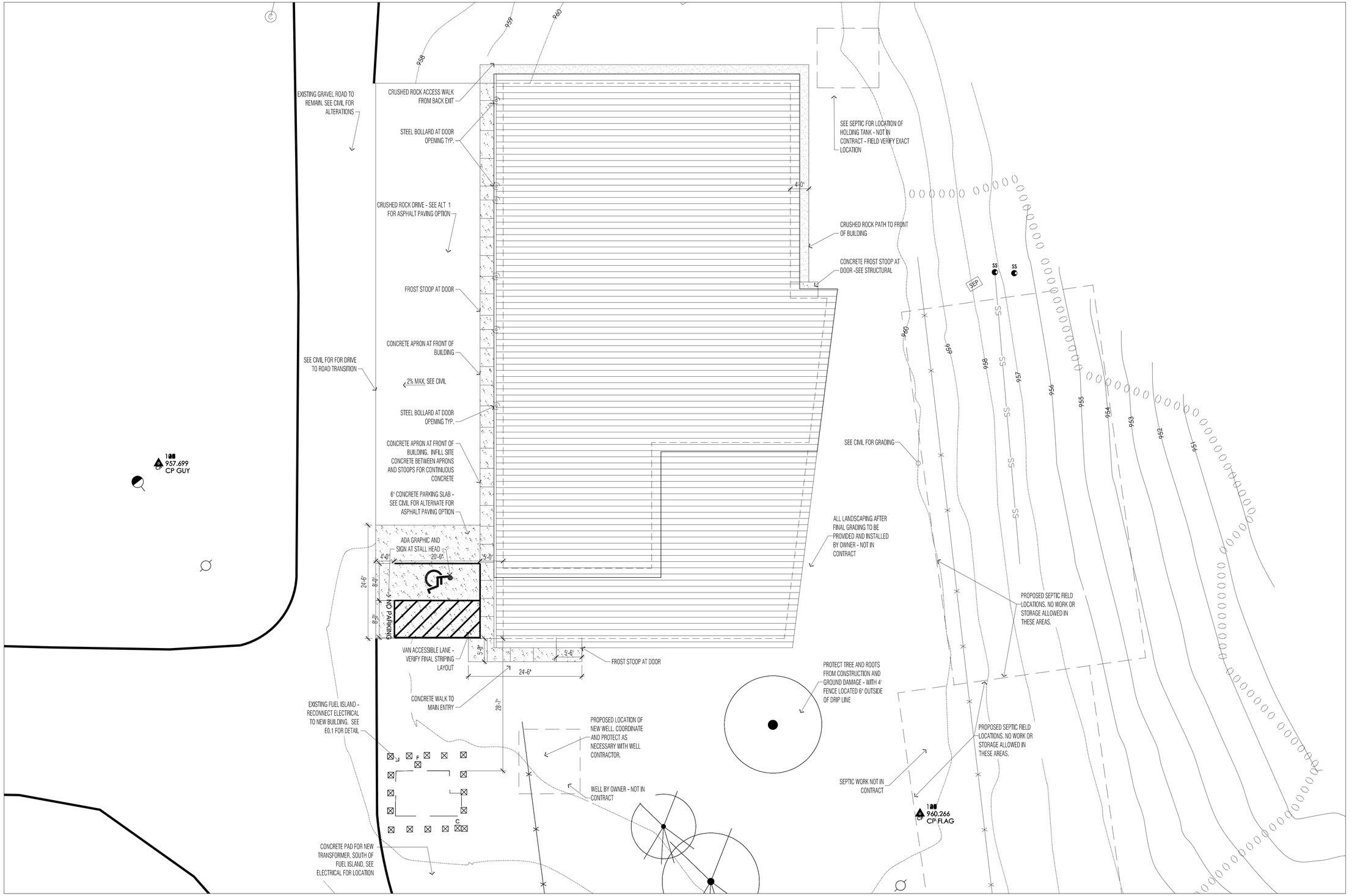
CHECKED BY: JLO

SHEET NAME:

SITE DEMO

SHEET NO:

A0.1



1 SITE PLAN

1" = 10'-0"

North

0' 10' 20'

PLOTTED: 7-25-2019 FILE NAME: A02_1942.DWG

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Signature

Jeffery L. Oertel
Name

15840 07/25/19
License # Date

PROJECT NUMBER: 18-42

DATE OF ISSUE: July 25, 2019

DRAWN BY: RAB

CHECKED BY: JLO

SHEET NAME:

SITE PLAN

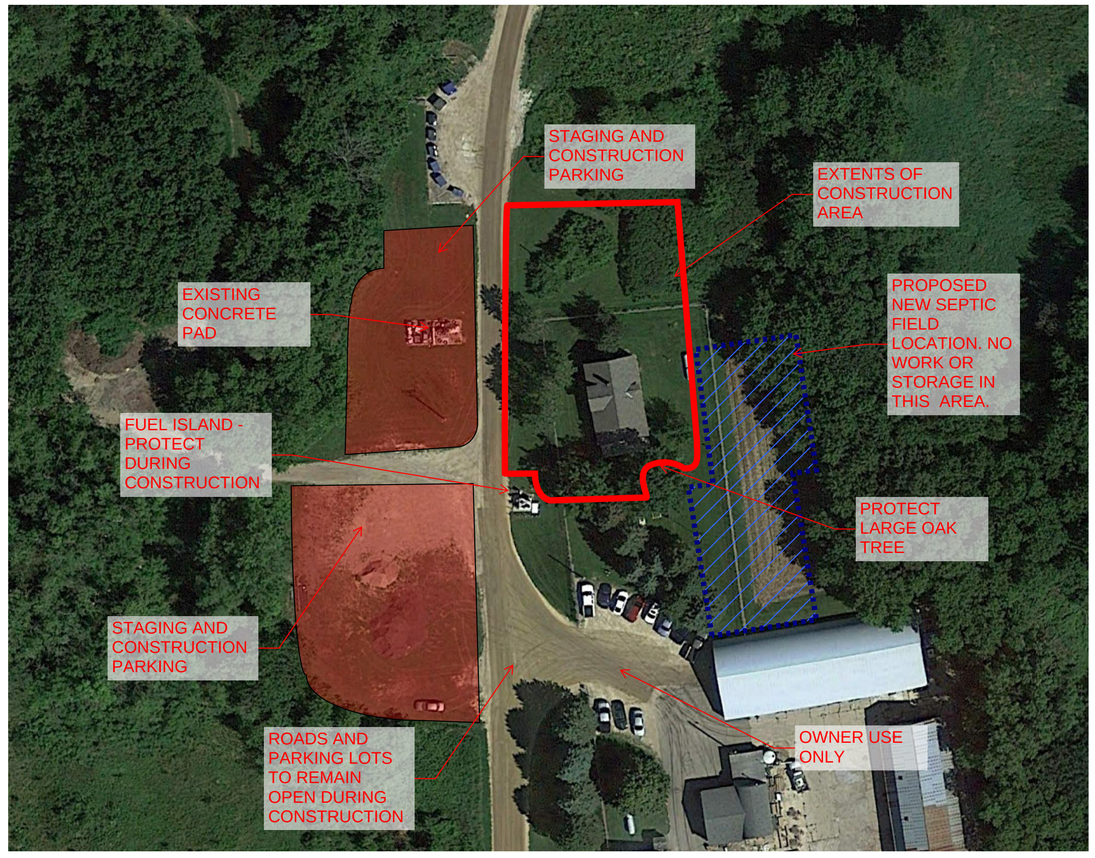
SHEET NO:

A0.2

1 EXCAVATION SPOILS LOCATIONS

N.T.S.

North



2 CONSTRUCTION LIMITS AND STAGING

N.T.S.

North

PLOTTED: 7-24-2019 FILE NAME: A0.3_1842.dwg

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Name

15840 07/25/19
License # Date

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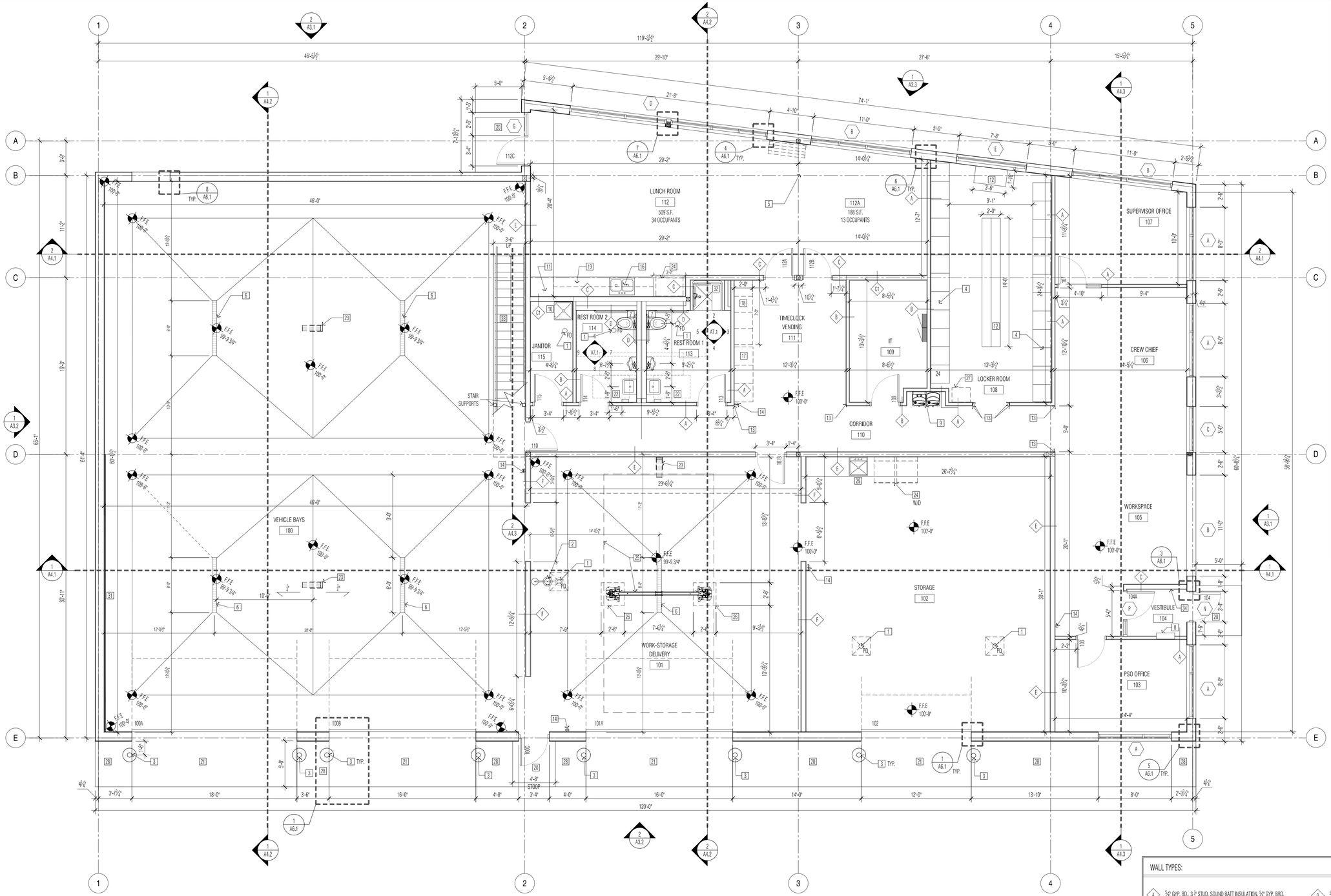
DRAWN BY: RAB

CHECKED BY: JLO

SHEET NAME:
CONSTRUCTION LIMITS AND STAGING PLAN

SHEET NO:
A0.3



FLOOR PLAN NOTES:

1. AREA DRAIN. PROVIDE 2-0" DIAMETER PITCH POCKET AROUND DRAIN (MAX. 2% SLOPE IN RESTROOM) -SEE MECH.
2. EMERGENCY EYE WASH & SHOWER - SEE MECH.
3. CONCRETE FILLED 6" DIAM. STEEL PIPE BOLLARD. PROVIDE PLASTIC BOLLARD COVERS AT EXTERIOR-TYP.
4. THIS ITEM IS AN ALTERNATE: (24) PREFIN. 24"x24" METAL LOCKERS
5. THIS ITEM IS AN ALTERNATE: OPERABLE PARTITION WALL
6. 6" PRE-FABRICATED POLY TRENCH DRAIN - SEE MECHANICAL
7. PROVIDE GRAB BARS PER MN STATE ACCESSIBILITY CODE - SECTION 1341
8. SEMI RECESSED CABINET UNIT HEATER
9. DUAL HEIGHT, ACCESSIBLE WATER COOLER AND JUG FILLER - SEE MECH. INSTALL PER MN STATE ACCESSIBILITY CODE, SECTION 1341
10. PREFAB. UTILITY FLOOR SINK w/ FRP SURROUND UP TO 48" ABOVE FINISHED FLOOR @ (2) SIDES
11. FULL HEIGHT CABINET SECTION. SEE INTERIOR ELEVATIONS
12. WOOD BENCHES
13. 3" X 3" X 6'-0" TALL STAINLESS STEEL CORNER WALL GUARDS
14. WALL MOUNTED FIRE EXTINGUISHER BY OWNER
15. NOT USED
16. STAINLESS STEEL MULTI-COMPARTMENT SINK - SEE MECH.
17. VENDING MACHINES - BY OWNER
18. RECYCLING RECEPTACLES - BY OWNER
19. PLAM COUNTER WITH P.LAM. UPPER AND LOWER CABINETRY. SEE INTERIOR ELEVATION FOR LAYOUT AND ADDITIONAL INFORMATION
20. STRUCTURAL CONCRETE STOOP - SEE STRUCTURAL FOUNDATION PLAN
21. CONCRETE APRONS
22. ELECTRIC HAND DRYERS
23. AIR REELS BY OWNER
24. APPLIANCES PROVIDED BY OWNER - SEE MECH./ELEC. FOR MORE INFO
25. FUTURE VEHICLE LIFT NOT IN CONTRACT
26. BLOCK OUT RADIANT TUBING THIS AREA FOR BOLT DOWN OF FUTURE LIFT - VERIFY LOCATION WITH OWNER PRIOR TO LAYOUT
27. PROVIDE BLOCKING IN WALL FOR OWNER SUPPLIED 80" HIGH BOOT DRYER
28. SITE CONCRETE BETWEEN APRONS - SEE SITE PLAN
29. UTILITY SINK - SEE MECHANICAL
30. BOILER / FURNACES- SEE MECHANICAL
31. FRP PANELS, 8' HIGH - PORTION OF NORTH WALL OF RM 100 -SEE PLAN
32. PRE-FABRICATED FIBERGLASS ADA SHOWER UNIT
33. STEEL STAIR, FULLY SELF SUPPORTING. PROVIDE 3/4" GAP TO PLYWOOD WALL AND FILL WITH SEALANT AT TOP. PAINT ALL STEEL.
34. WATER MAIN ACCESS PANEL

WALL TYPES:

- A — 5/8" GYP. BD., 3 5/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- A1 — 5/8" TILE BACKER, 3 5/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- B — 3/4" SANDED PLYWOOD, 3 5/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- C — 5/8" GYP. BD., 5 3/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- C1 — 5/8" GYP. BD., 5 3/8" STUD, SOUND BATT INSULATION, 3/4" SANDED PLYWOOD
- D — 5/8" TILE BACKER BRD., 5 3/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- E — 3/4" SANDED PLYWOOD (RM 109 SIDE), 5 3/8" STUD, SOUND BATT INSULATION, 5/8" GYP. BRD.
- F — 3/4" SANDED PLYWOOD , 5 3/8" STUD, 3/4" SANDED PLYWOOD.

* PROVIDE WATER RESISTANT BACKING BOARD OR EQUAL @ ALL REST ROOM, LOCKER ROOM, & SHOWER LOCATIONS

NOTE:
ALL WALLS ARE FULL-HEIGHT, TO UNDERSIDE OF DECK, U.N.O.

1 PLAN
MAIN FLOOR 3/16" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A1.1_1842.dwg

ThreeRivers PARK DISTRICT
in partnership with
Scott County

CONSULTANT:
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REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

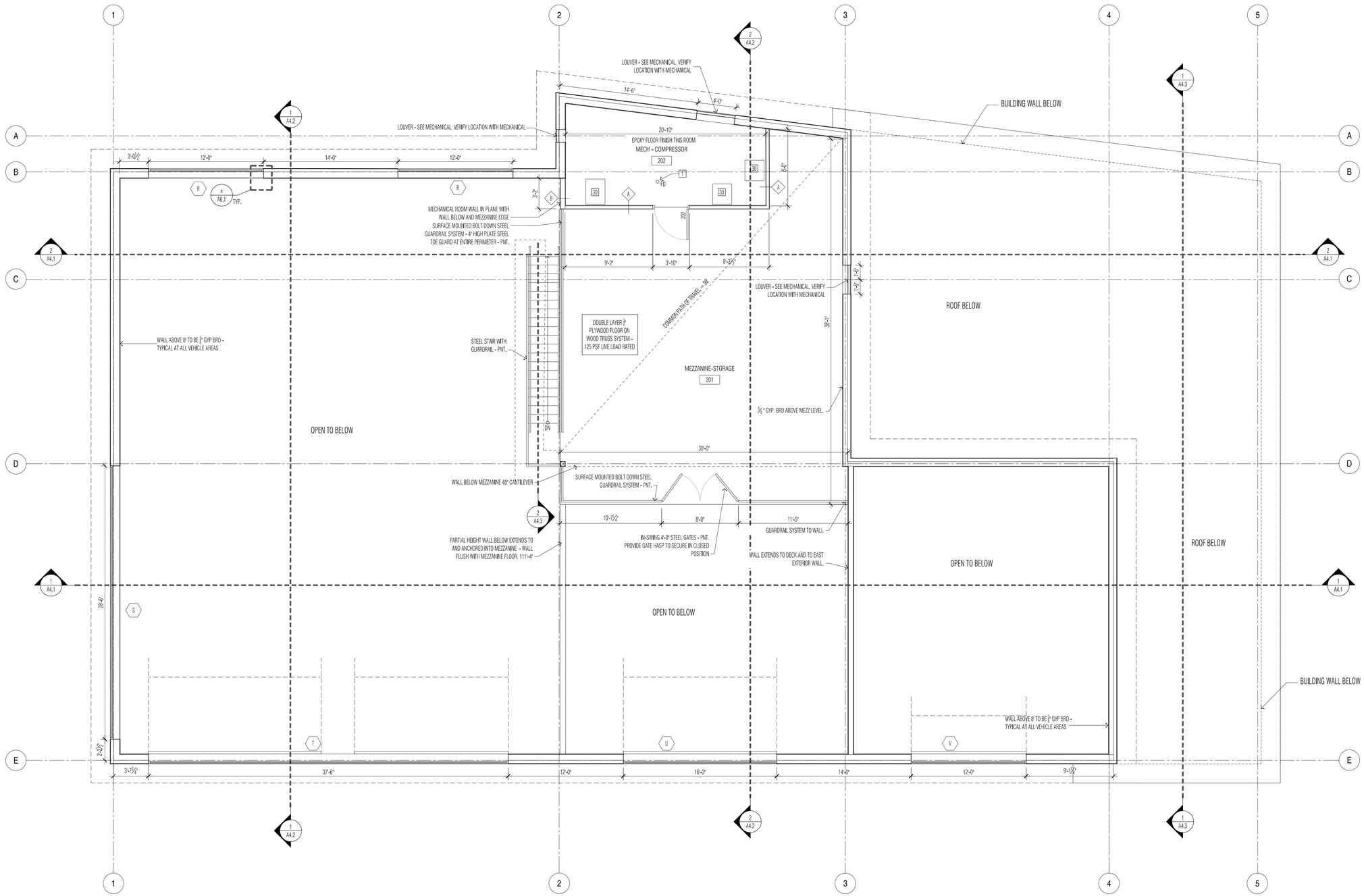
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature
Jeffery L. Oertel
Name
15840 License #
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RAB
CHECKED BY: JLO

SHEET NAME:
MAIN FLOOR PLAN

SHEET NO:
A1.1



1 MEZZANINE PLAN

3/16" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A1.2_1842.dwg

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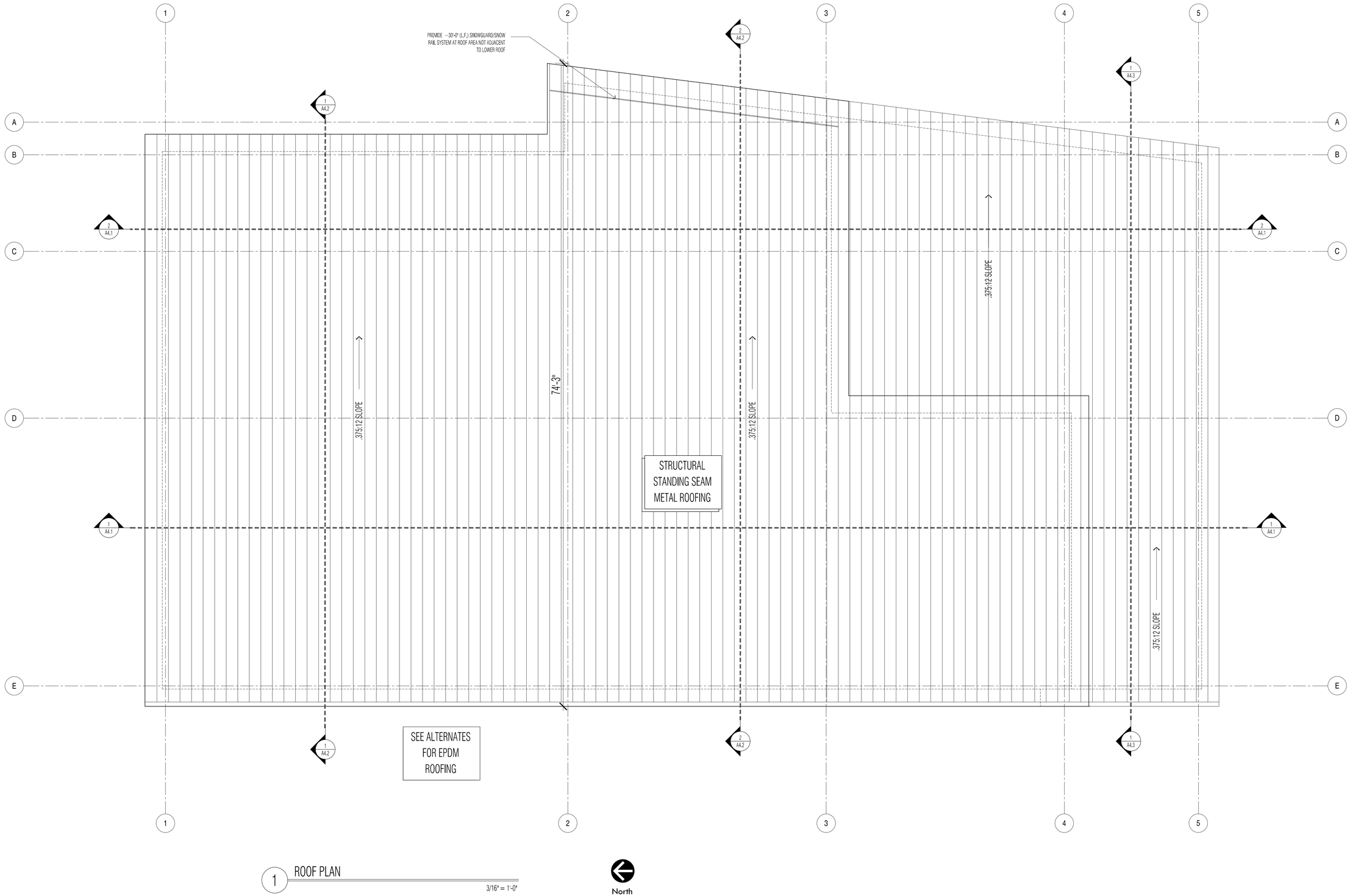
SHEET NAME:

MEZZANINE PLAN

SHEET NO:

A1.2



1 ROOF PLAN

3/16" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A1.3 roof_1842.dwg

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DRAWN BY: RAB

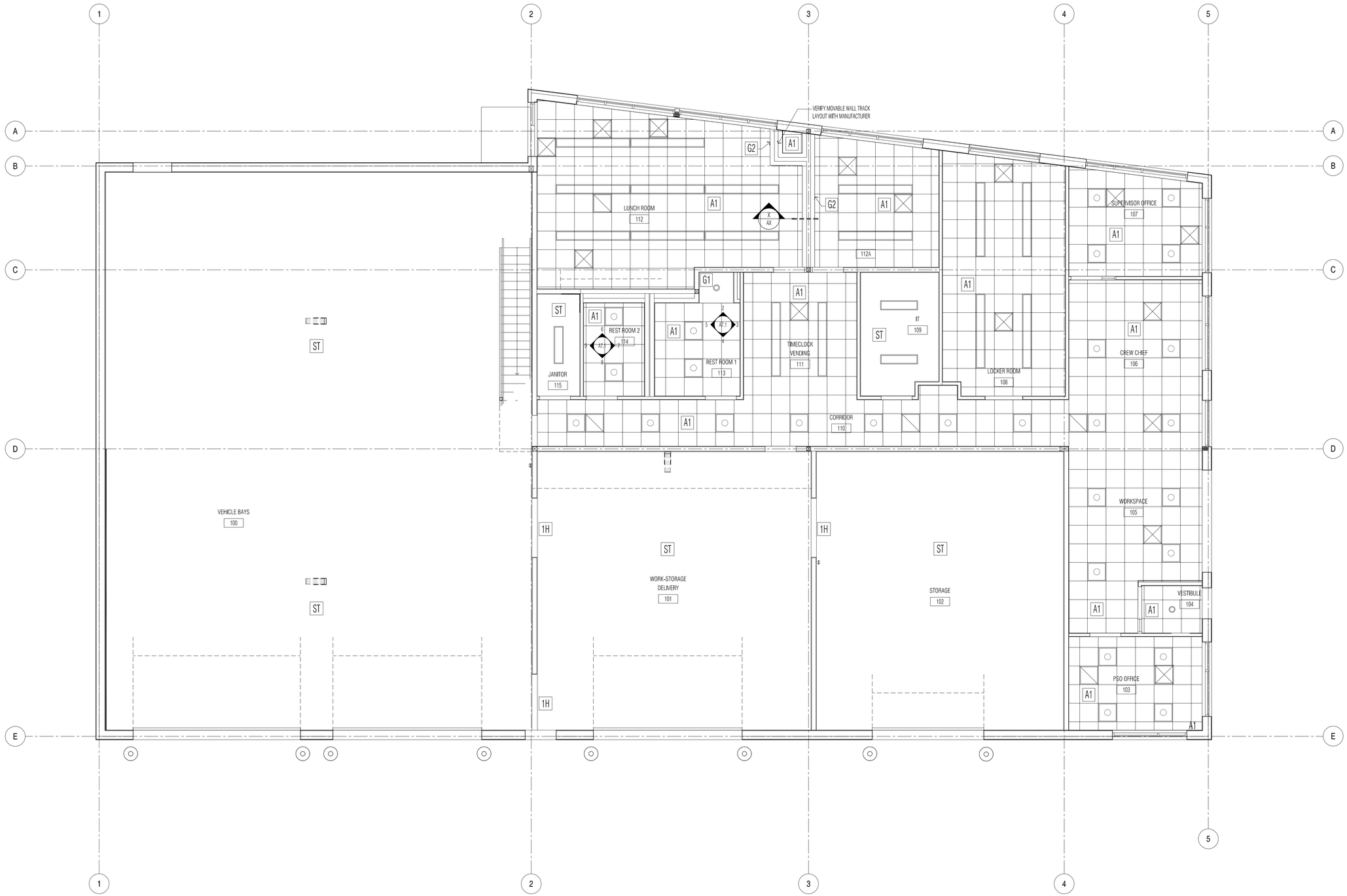
CHECKED BY: JLO

SHEET NAME:

ROOF PLAN

SHEET NO:

A1.4



1 REFLECTED CEILING PLAN
MAIN FLOOR 3/16" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A21_1842.dwg

LEGEND

- 2x2 LIGHT FIXTURE
- 2x4 LIGHT FIXTURE
- 1x8 LIGHT FIXTURE
- HIGHBAY FIXTURE
- RECESSED DOWNLIGHT
- RETURN GRILL
- SUPPLY DIFFUSER
- SUPPLY DIFFUSER
- GYP. BOARD CEILING
- A.C.T. CEILING

NOTE: SEE MECHANICAL & ELECTRICAL DRAWINGS FOR FURTHER INFORMATION. COORDINATE / VERIFY FINAL FIXTURE LAYOUT AND LOCATION WITH OWNER & ARCHITECT PRIOR TO INSTALLATION

CEILING PLAN NOTES

- A1 A.C.T. CLG. @ 8'-8" A.F.F.
- G1 GYP. CLG. @ 8'-0"
- G2 GYP. SOFFIT AT 8'-8"
- 1H PLYWOOD HEADER @ 8'-8" +/- A.F.F.
- ST OPEN TO STRUCTURE ABOVE

NOTE: PROVIDE ALL REQUIRED FRAMING, CARRY FRAMING, SOUND BATT, & GYP. BOARD TO UNDERSIDE OF DECK - TYPICAL AT ALL LOCATIONS. PROVIDE CROSS-BRACING AS REQD.

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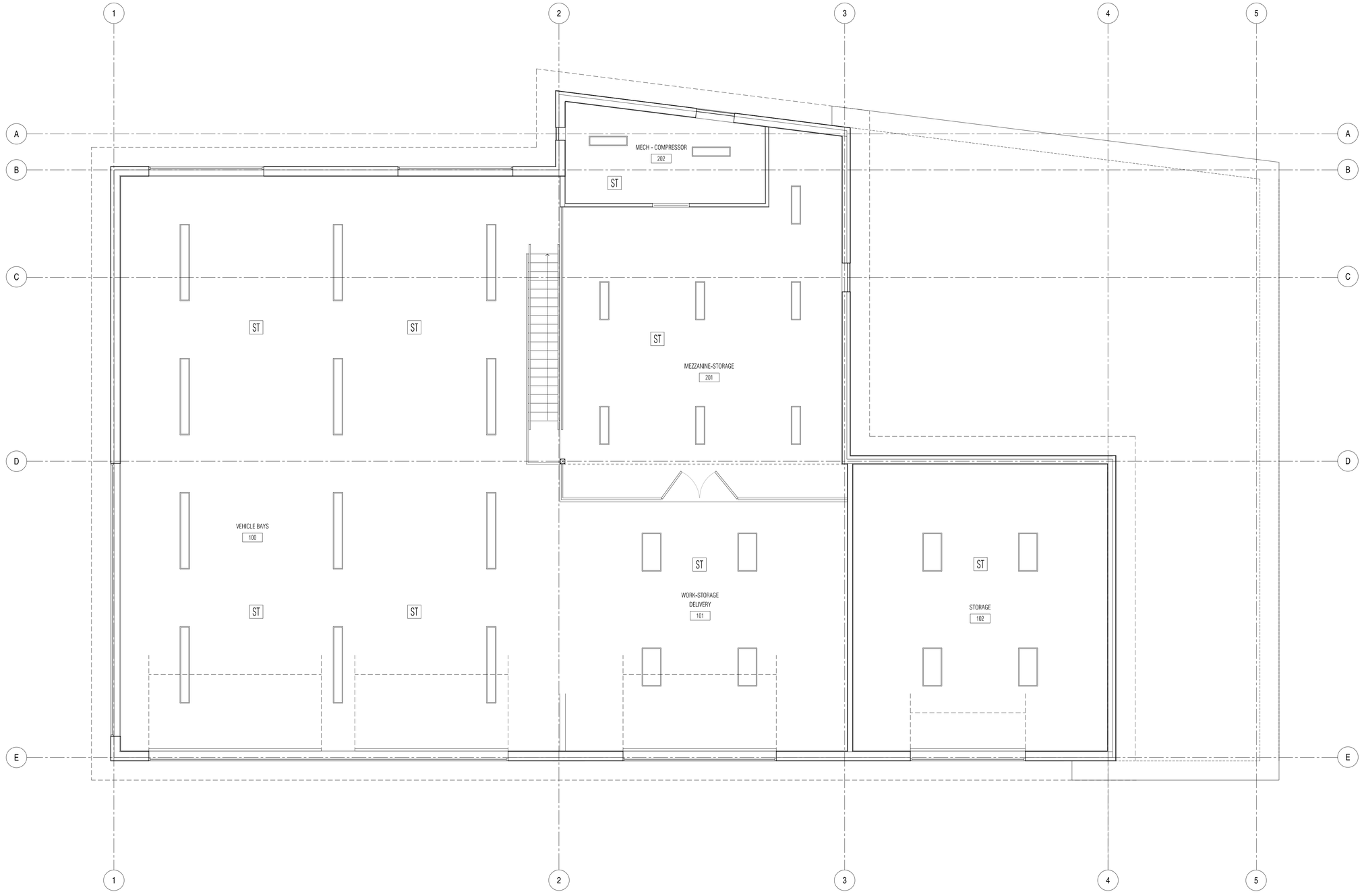
SHEET NAME:
REFLECTED CEILING PLAN MAIN FLOOR

SHEET NO:
A2.1



LEGEND

- 2x2 LIGHT FIXTURE
- 2x4 LIGHT FIXTURE
- 1x8 LIGHT FIXTURE
- HIGHBAY FIXTURE
- RECESSED DOWNLIGHT
- RETURN GRILL
- SUPPLY DIFFUSER
- SUPPLY DIFFUSER
- GYP. BOARD CEILING
- A.C.T. CEILING

NOTE: SEE MECHANICAL & ELECTRICAL DRAWINGS FOR FURTHER INFORMATION, COORDINATE / VERIFY FINAL FIXTURE LAYOUT AND LOCATION WITH OWNER & ARCHITECT PRIOR TO INSTALLATION

CEILING PLAN NOTES

- A1 A.C.T. CLG. @ 8'-6" A.F.F.
- G1 GYP. CLG. @ 8'-0"
- G2 GYP. SOFFIT AT 8'-6"
- SH PLYWOOD HEADER @ 8'-6" +/- A.F.F.
- ST OPEN TO STRUCTURE ABOVE

NOTE: PROVIDE ALL REQUIRED FRAMING, CARRY FRAMING, SOUND BATT, & GYP. BOARD TO UNDERSIDE OF DECK - TYPICAL AT ALL LOCATIONS. PROVIDE CROSS-BRACING AS REQ'D.

1 REFLECTED CEILING PLAN
MEZZANINE LEVEL 3/16" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A21_1842.dwg

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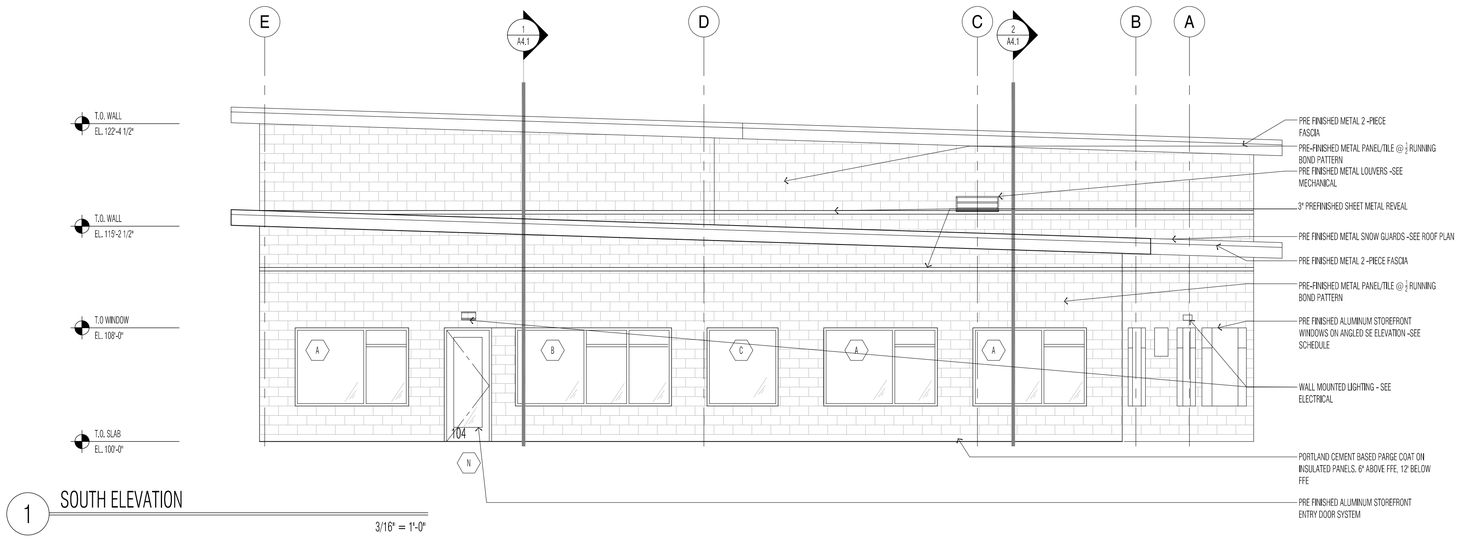
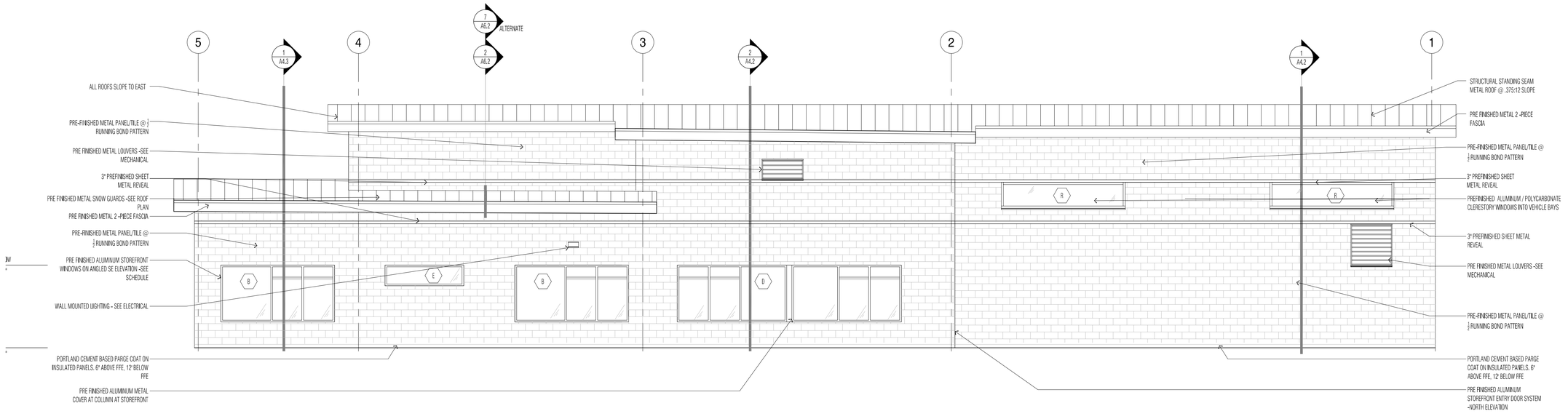
SHEET NAME:
REFLECTED CEILING PLAN MEZZANINE

SHEET NO:
A2.2



1 SOUTH ELEVATION

3/16" = 1'-0"



2 EAST ELEVATION

3/16" = 1'-0"

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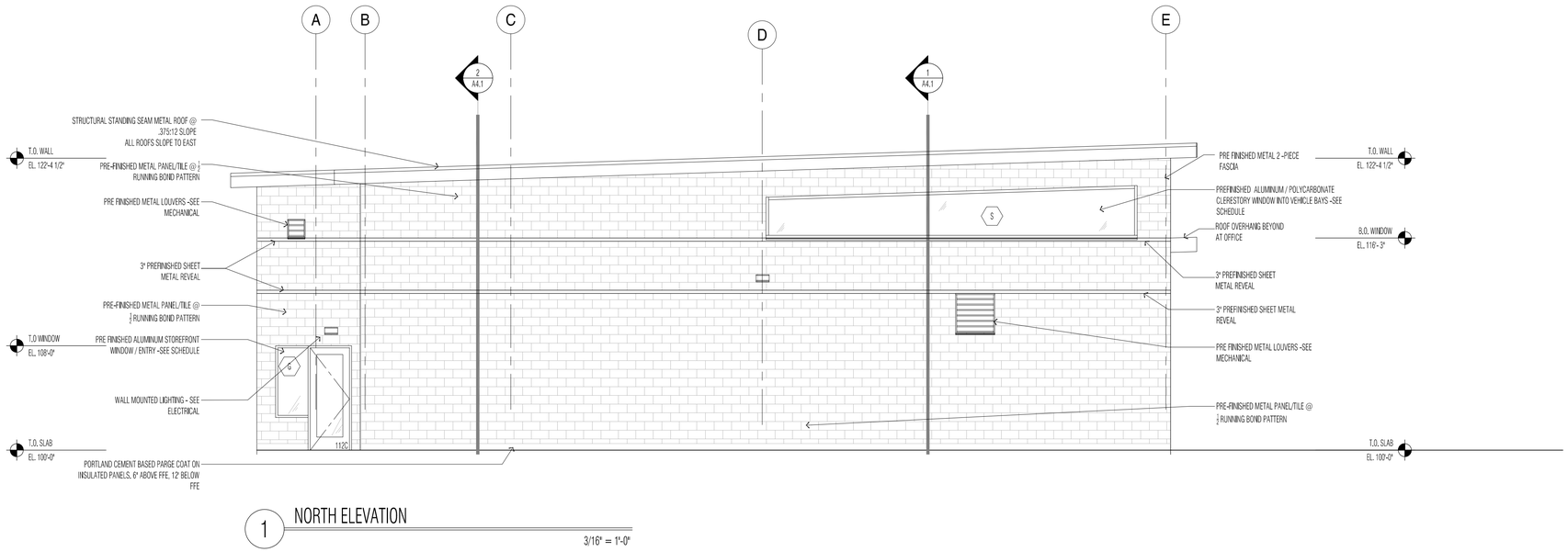
SHEET NAME:

ELEVATIONS

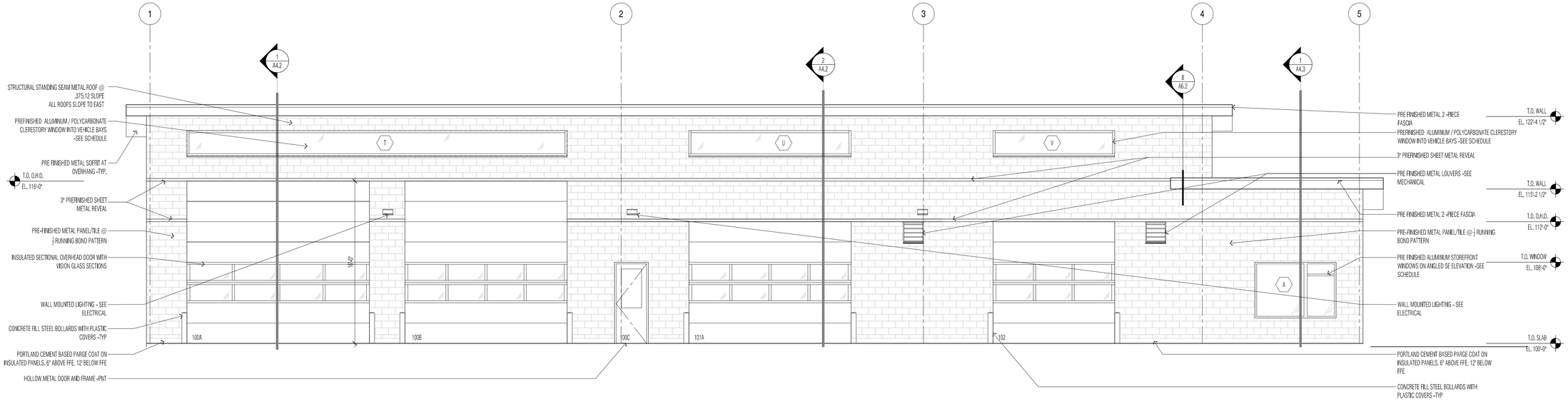
SHEET NO:

A3.1



1 NORTH ELEVATION

3/16" = 1'-0"



2 WEST ELEVATION

3/16" = 1'-0"

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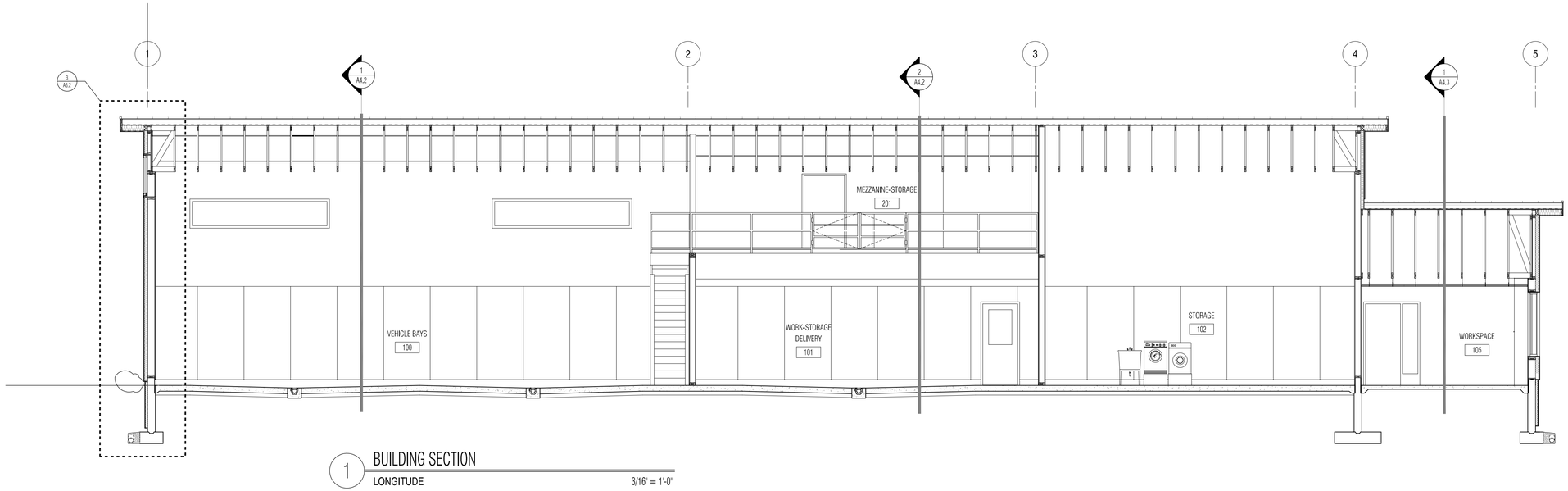
SHEET NAME:

ELEVATIONS

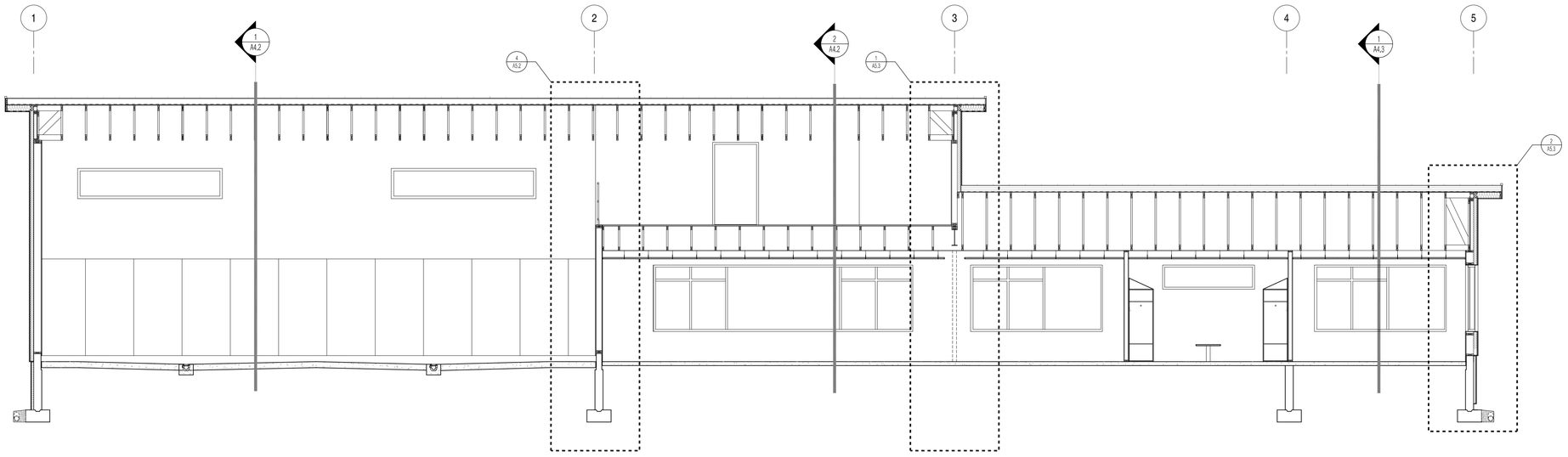
SHEET NO:

A3.2



1 BUILDING SECTION

LONGITUDE 3/16" = 1'-0"



2 BUILDING SECTION

LONGITUDE 3/16" = 1'-0"

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6246 190th St. E.
Prior Lake, MN 55372

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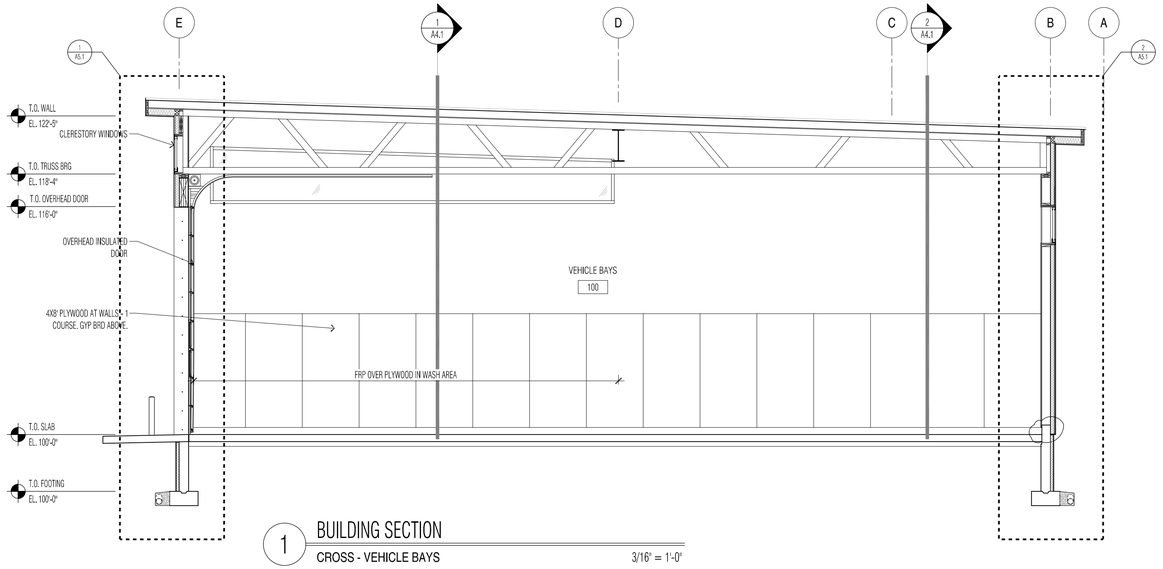
SHEET NAME:

BUILDING SECTIONS

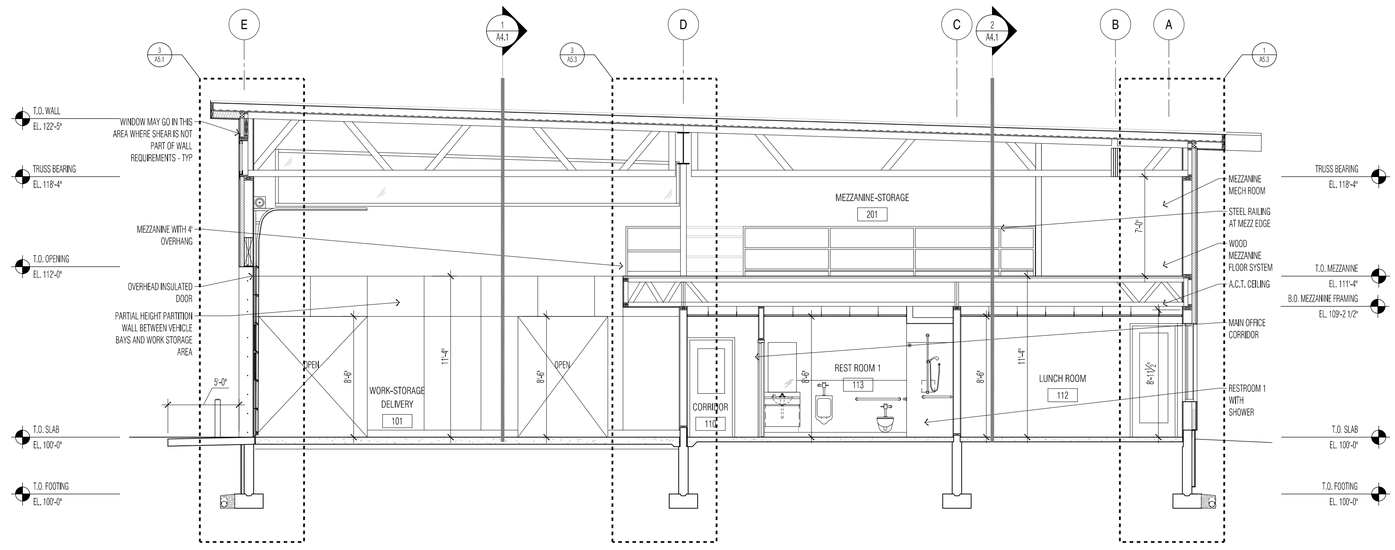
SHEET NO:

A4.1



1 BUILDING SECTION

CROSS - VEHICLE BAYS 3/16" = 1'-0"



2 BUILDING SECTION

CROSS - WORK-STORAGE 3/16" = 1'-0"

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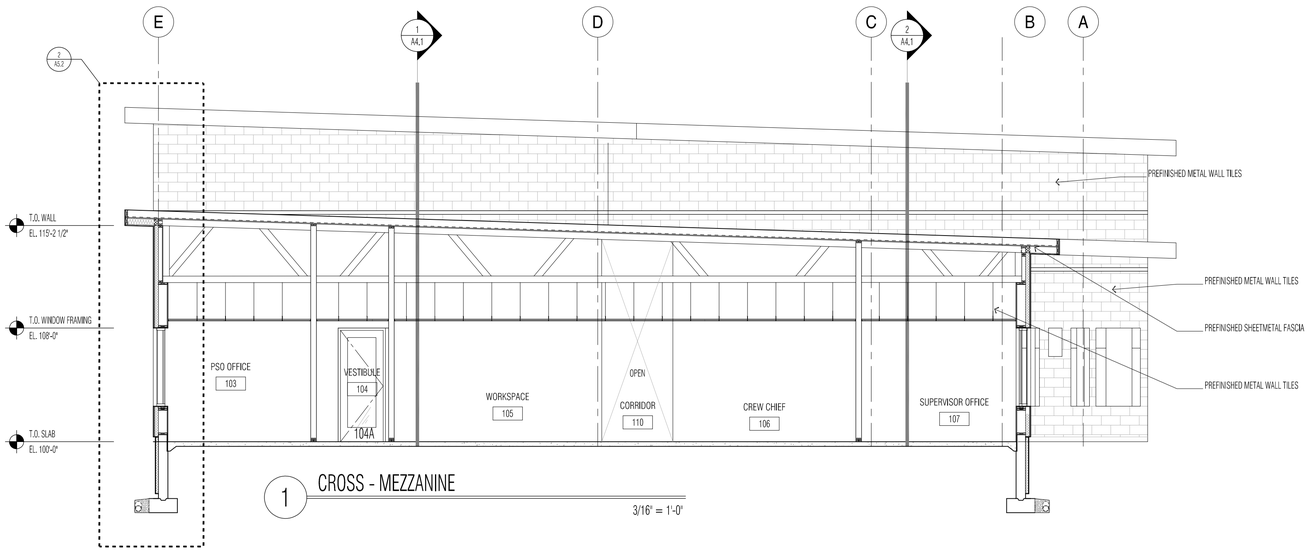
SHEET NAME:

BUILDING SECTIONS

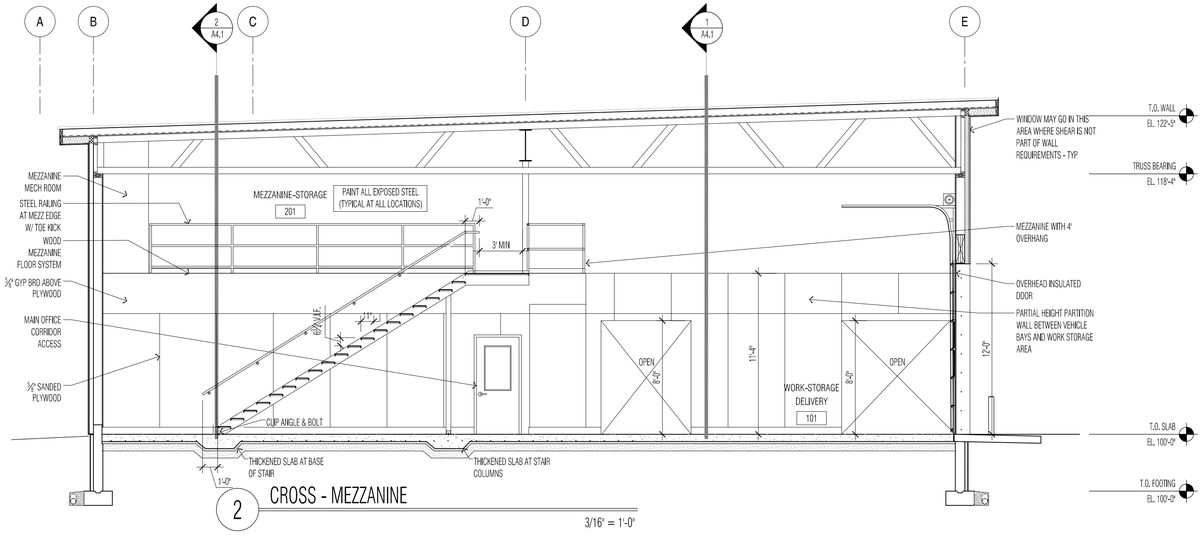
SHEET NO:

A4.2



1 CROSS - MEZZANINE

3/16" = 1'-0"



2 CROSS - MEZZANINE

3/16" = 1'-0"

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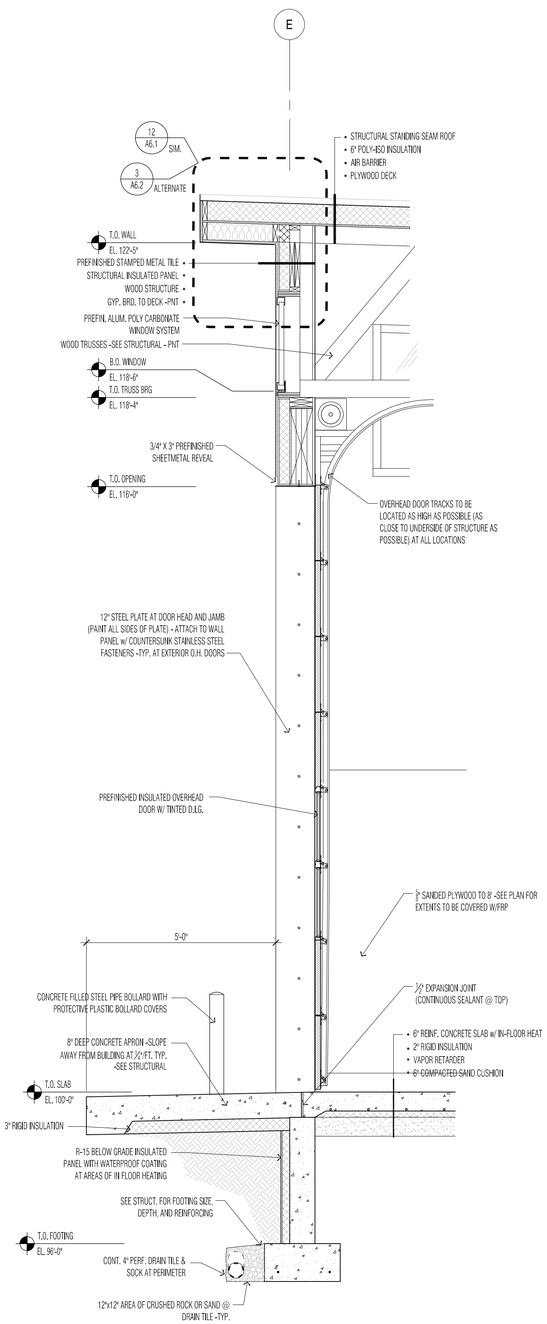
SHEET NAME:

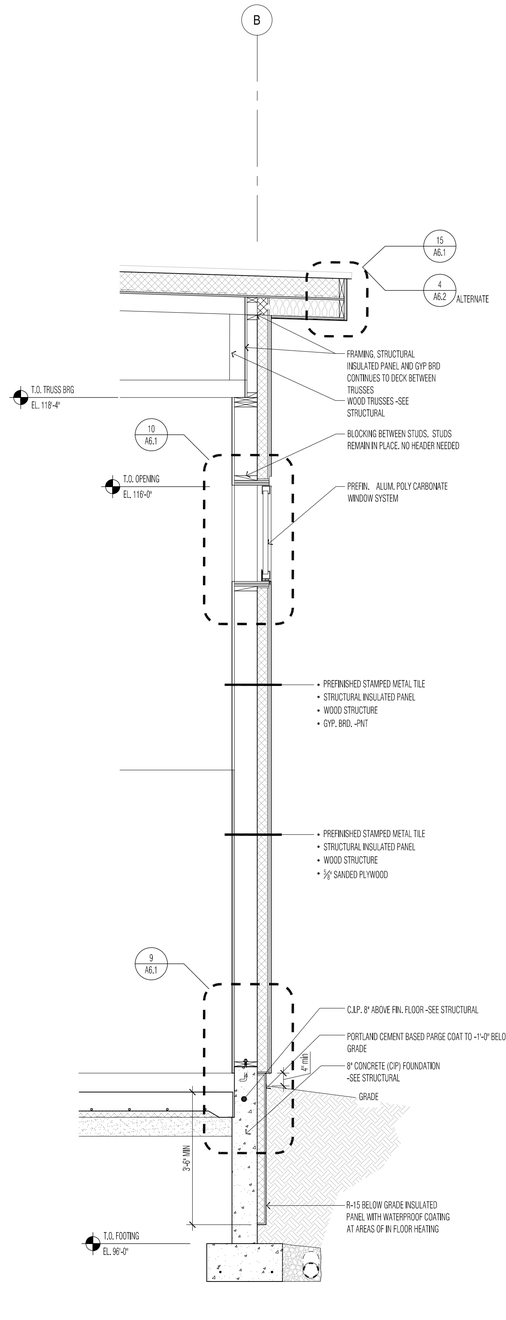
BUILDING SECTIONS

SHEET NO:

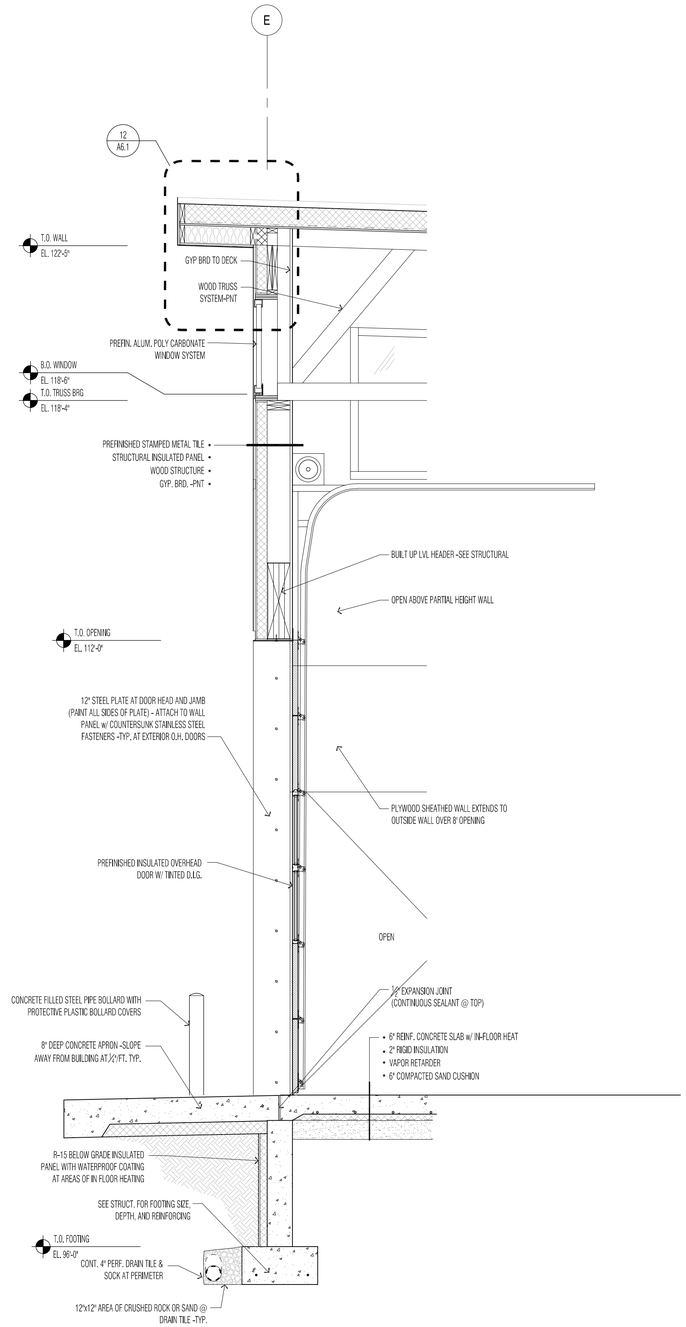
A4.3



1 WALL SECTION
AT VEHICLE BAYS 1/2" = 1'-0"



2 WALL SECTION
AT VEHICLE BAYS 1/2" = 1'-0"



3 WALL SECTION
AT WORK STORAGE 1/2" = 1'-0"

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CLEARY LAKE
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MAINTENANCE BLDG
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Name
15840 07/25/19
License # Date

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DRAWN BY: RAB
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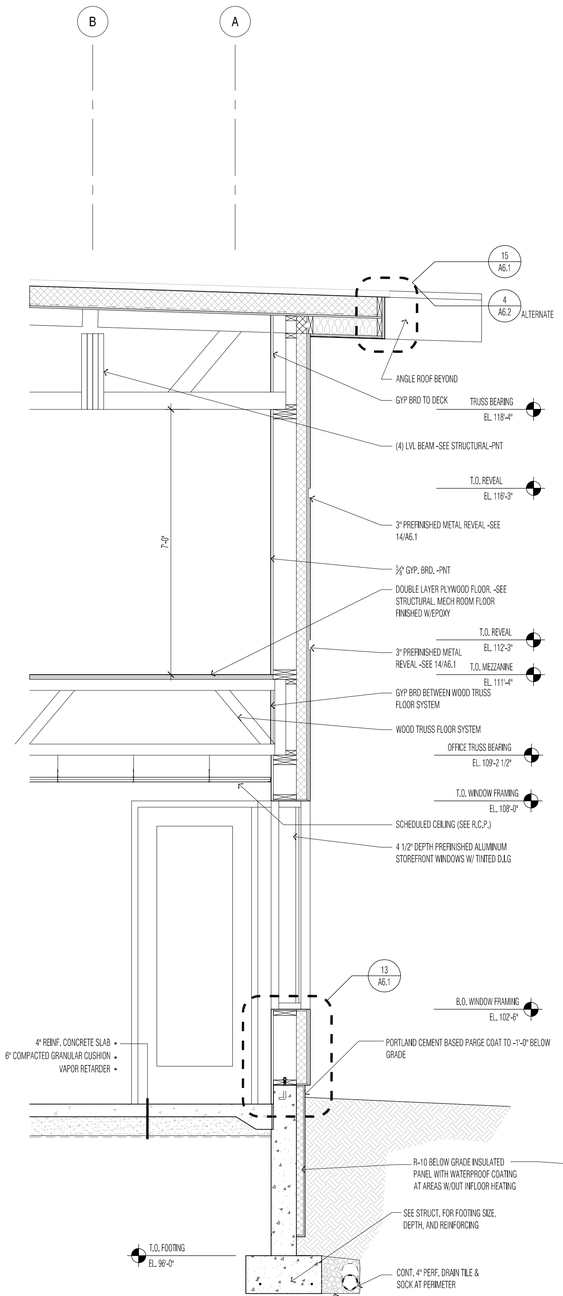
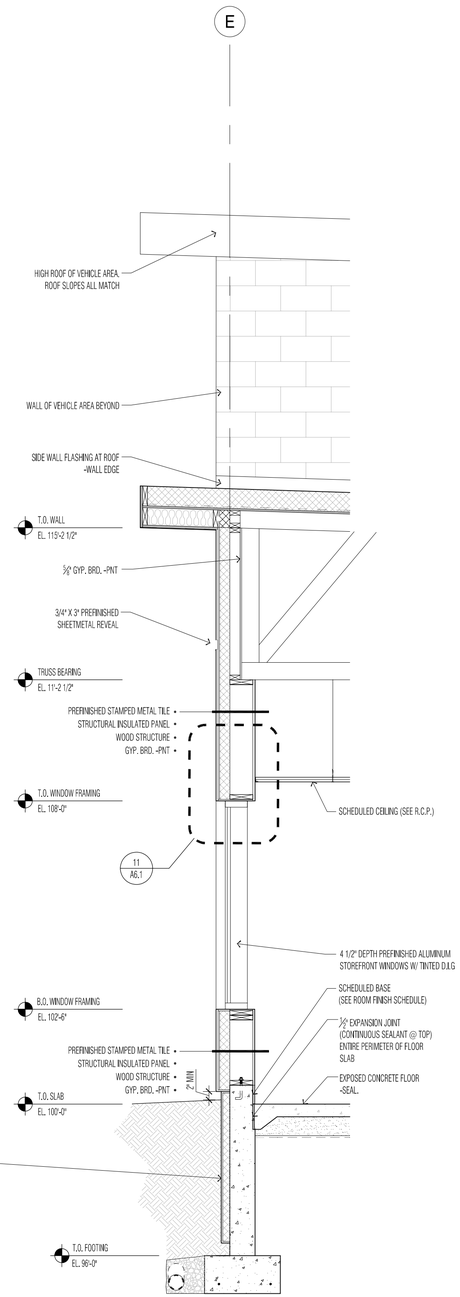
SHEET NAME:
WALL
SECTIONS

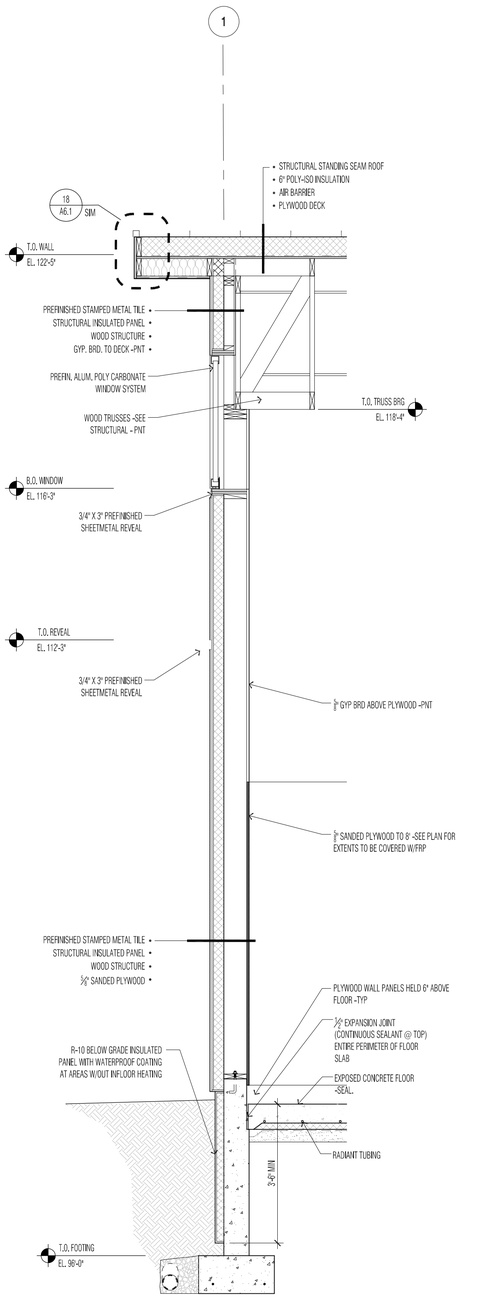
SHEET NO:
A5.1



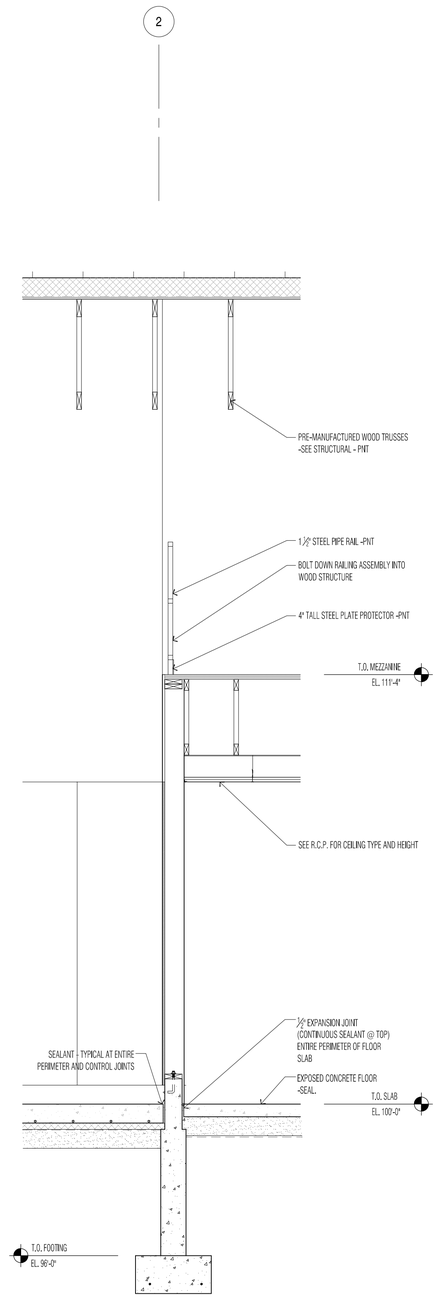
1 WALL SECTION
AT LUNCHROOM/MEZZANINE — 1/2" = 1'-0"



2 WALL SECTION
AT OFFICE — 1/2" = 1'-0"



3 WALL SECTION
AT VEHICLE BAY — 1/2" = 1'-0"



4 WALL SECTION
AT VEHICLE BAY — 1/2" = 1'-0"

ThreeRivers PARK DISTRICT
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Scott County
CONSULTANT:
OERTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
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6246 190th St. E.
Prior Lake, MN 55372

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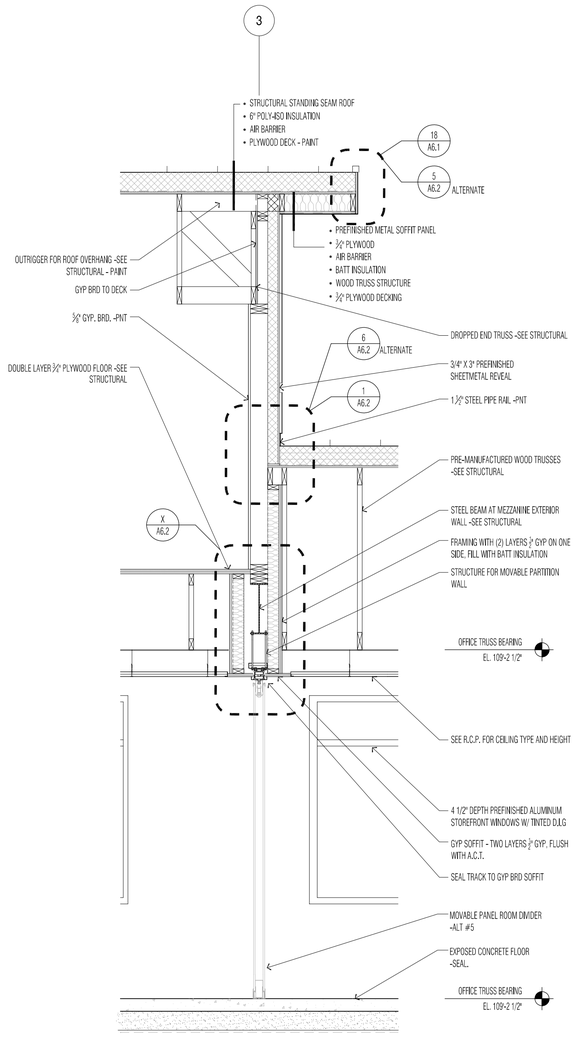
Signature
Jeffery L. Oertel
Name
15840 — License #
07/25/19 — Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RAB
CHECKED BY: JLO

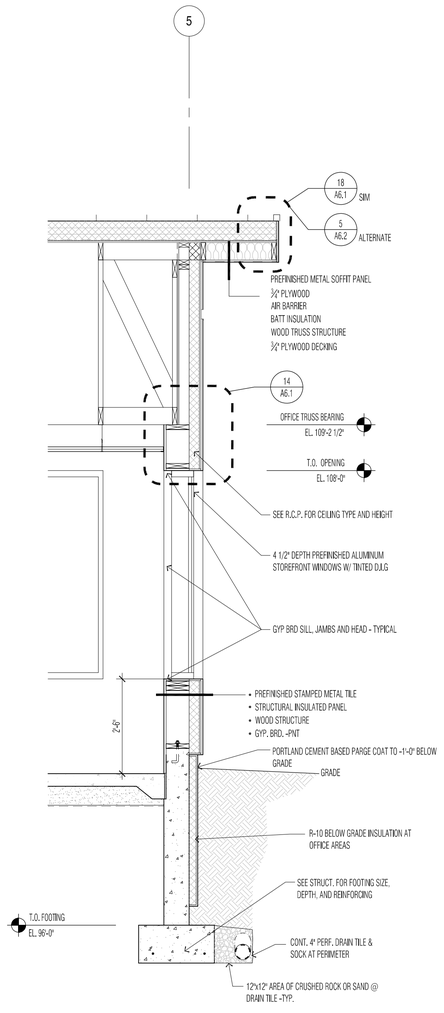
SHEET NAME:
WALL SECTIONS

SHEET NO:
A5.2

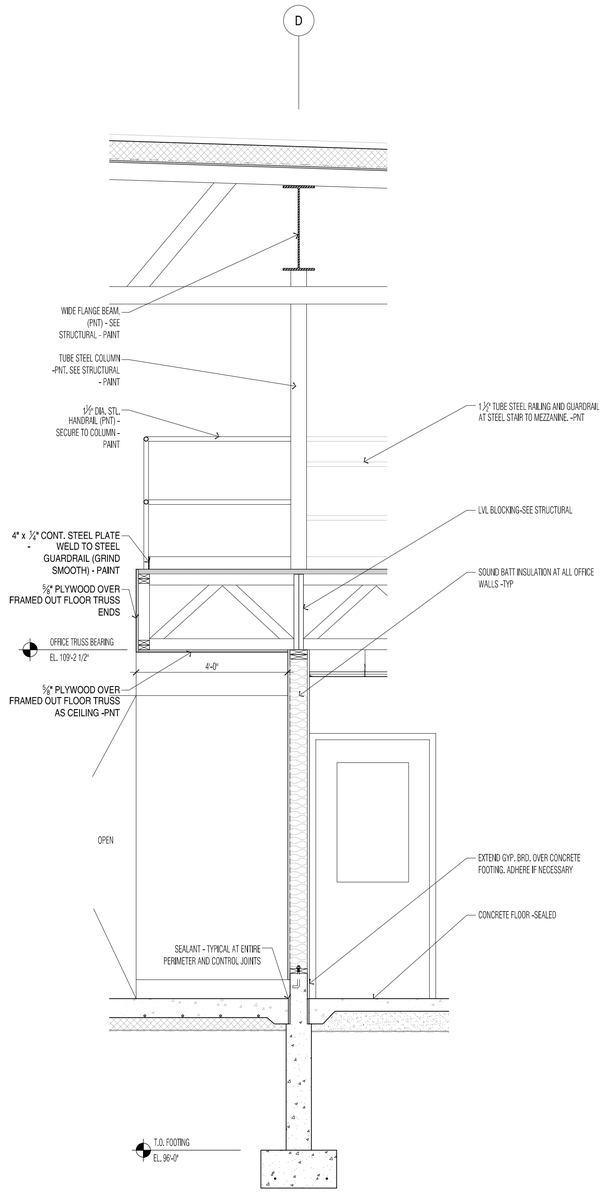
PLOTTED: 7-25-2019 FILE NAME: A5.1_1912.dwg



1 WALL SECTION
AT LUNCH ROOM MEZZANINE 1/2" = 1'-0"



2 WALL SECTION
AT OFFICE 1/2" = 1'-0"



3 WALL SECTION
AT MEZZANINE 1/2" = 1'-0"

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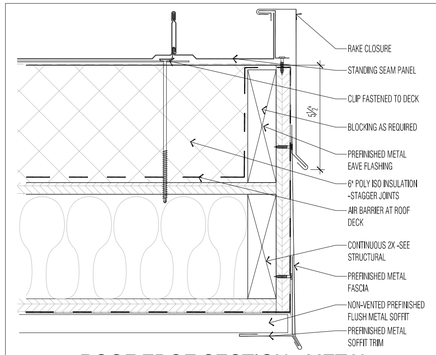
SHEET NAME:
WALL SECTIONS

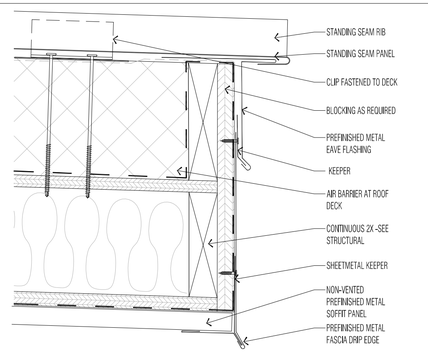
SHEET NO:
A5.3

PLOTTED: 7-25-2019 FILE NAME: A5.1_1842.dwg



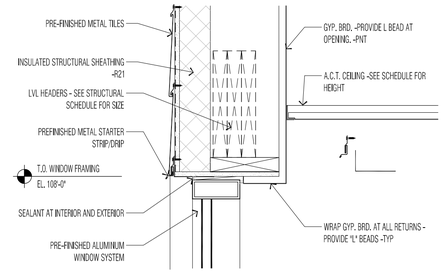
18 ROOF EDGE SECTION - METAL

RAKE EDGE — 3"=1'-0"



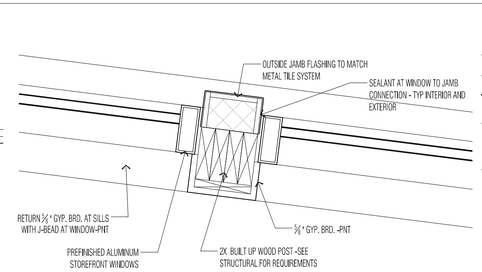
15 ROOF EDGE SECTION - METAL

LOWER EAVE EDGE — 3"=1'-0"



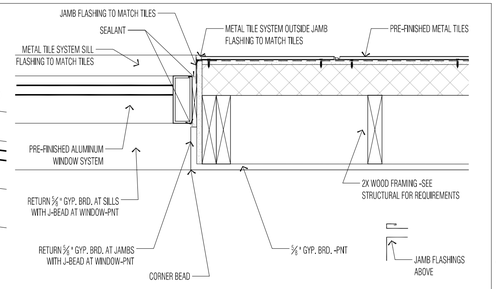
11 DETAIL

HEAD AT OFFICE ALUMINUM WINDOWS — 1-1/2" = 1'-0"



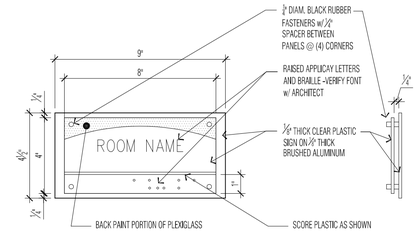
7 PLAN DETAIL

AT WINDOW 'D' STRUCTURAL CENTER JAMB — 1-1/2" = 1'-0"



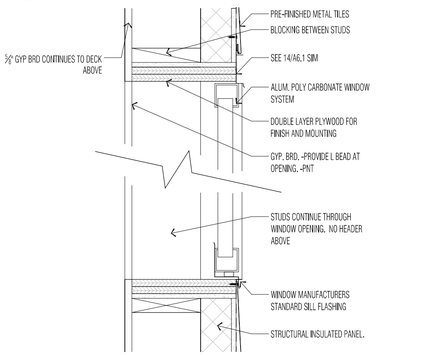
4 PLAN DETAIL

AT WINDOW JAMB - TYPICAL — 1-1/2" = 1'-0"



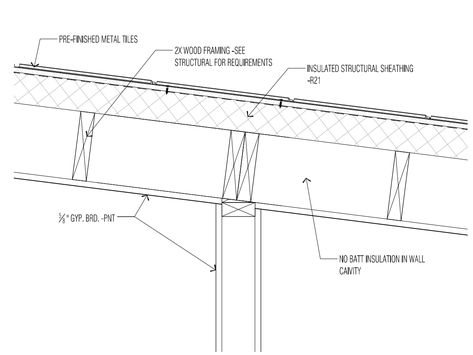
17 INTERIOR SIGNAGE

TYPICAL SIGNAGE -BY OWNER N.I.C. — 3"=1'-0"



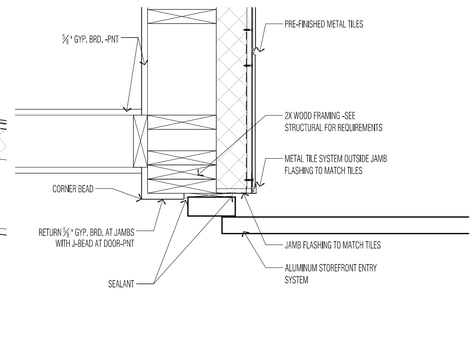
10 DETAIL

ALUM/POLYCARBONATE WINDOW - TYP — 1-1/2" = 1'-0"



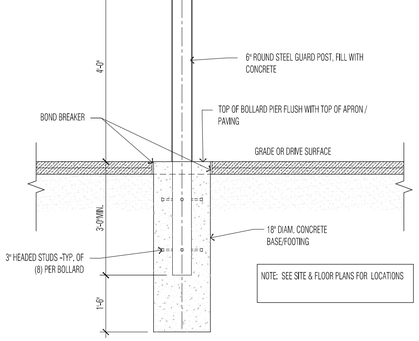
6 PLAN DETAIL

AT INTERIOR/EXTERIOR WALL INTERSECTION — 1-1/2" = 1'-0"



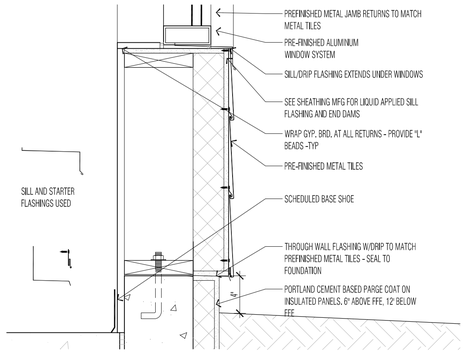
3 DETAIL

AT ALUMINUM ENTRY DOOR JAMB — 1-1/2" = 1'-0"



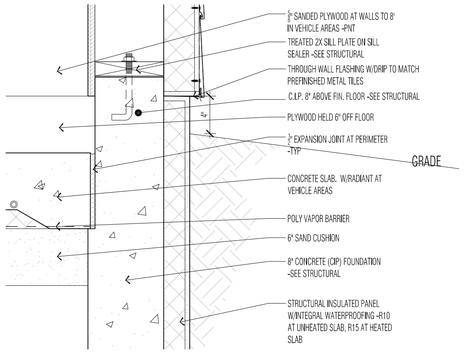
16 DETAIL

AT BOLLARDS - TYP — 1/2" = 1'-0"



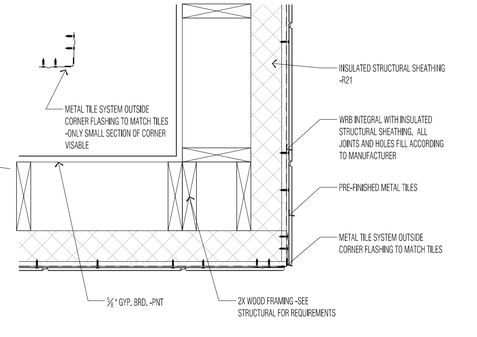
13 DETAIL

WALL BASE/WINDOW OPENING - TYP — 1-1/2" = 1'-0"



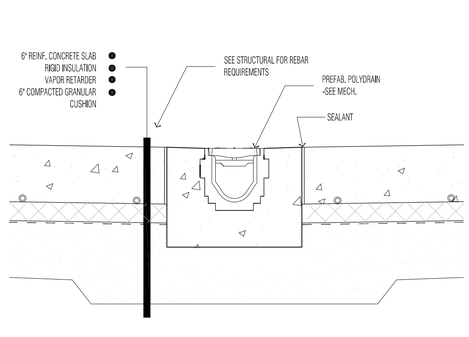
9 DETAIL

AT WALL SILL - TYP — 1- 1/2" = 1'-0"



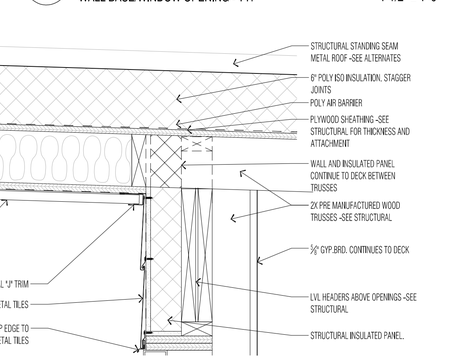
5 DETAIL

AT EXTERIOR WALL CORNER — 1-1/2" = 1'-0"



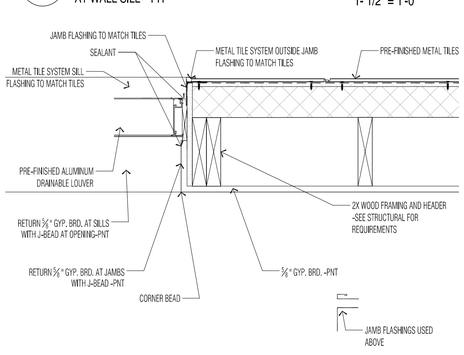
2 DETAIL

AT TRENCHDRAINS - TYPICAL — 1-1/2" = 1'-0"



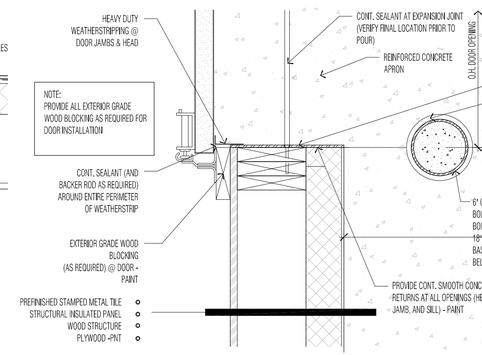
12 DETAIL

ROOF OVEWRHANG - TYP — 1-1/2" = 1'-0"



8 PLAN DETAIL

LOUVER OPENING - TYP — 1-1/2" = 1'-0"



1 DETAIL

AT OVERHEAD DOORS / BOLLARDS - TYP — 1-1/2" = 1'-0"

PLOTTED: 7-25-2019 FILE NAME: A6.1_1842.dwg

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15840 — License #
07/25/19 — Date

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CHECKED BY: JLO

SHEET NAME:
DETAILS

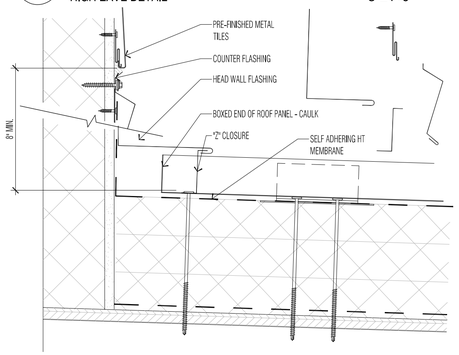
SHEET NO:
A6.1

6 ROOF-WALL EDGE SECTION - EPDM

SIDE WALL — 3"=1'-0"

3 ROOF EDGE SECTION - EPDM

HIGH EAVE DETAIL — 3"=1'-0"

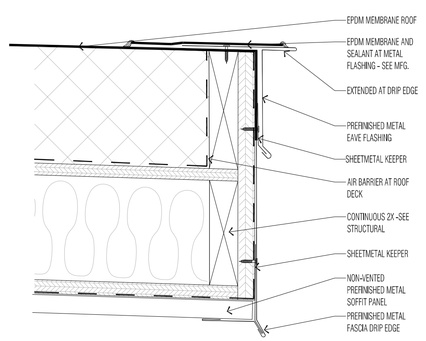


8 SECTION DETAIL

ROOF EXTENSION RETURN — 1-1/2" = 1'-0"

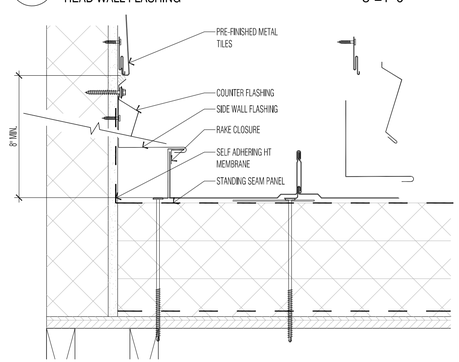
5 ROOF EDGE SECTION - EPDM

RAKE EDGE — 3"=1'-0"



2 ROOF EDGE SECTION - STEEL

HEAD WALL FLASHING — 3"=1'-0"



7 ROOF-WALL EDGE SECTION - EPDM

HEAD WALL — 3"=1'-0"

4 ROOF EDGE SECTION - EPDM

LOWER EAVE EDGE — 3"=1'-0"

1 ROOF-WALL EDGE SECTION - METAL

SIDE WALL FLASHING — 3"=1'-0"

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ThreeRivers PARK DISTRICT

in partnership with

Scott County

CONSULTANT:

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Name

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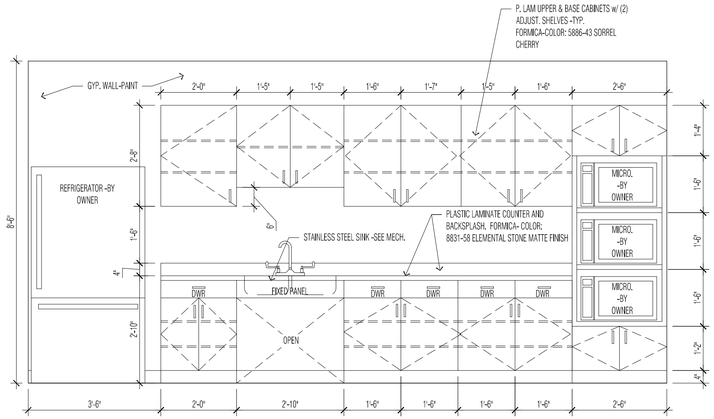
SHEET NAME:

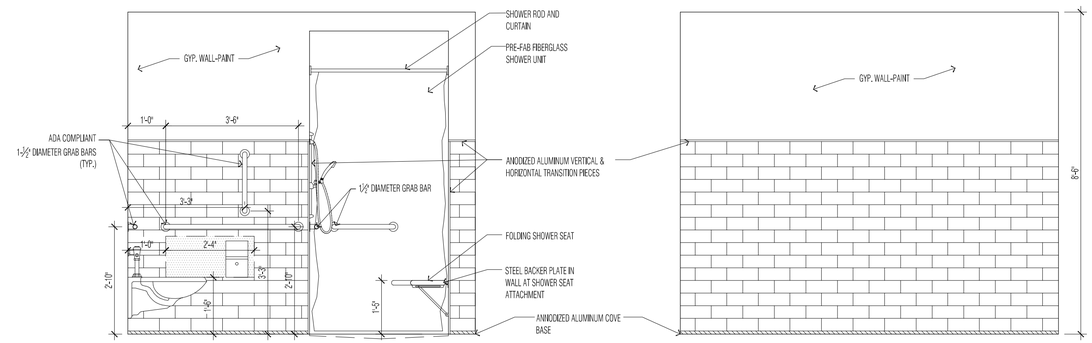
DETAILS

SHEET NO:

A6.2

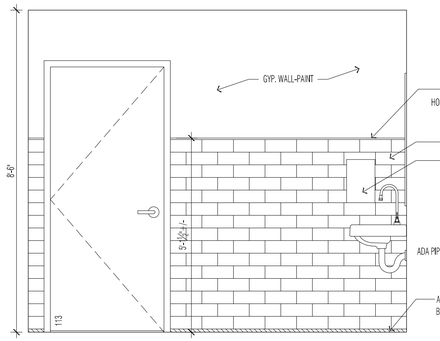


1 LUNCH ROOM
ROOM 112 — 1/2"=1'-0"

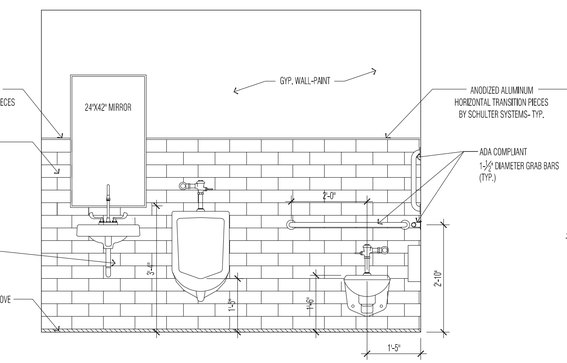


2 RESTROOM 1
ROOM 113 — 1/2"=1'-0"

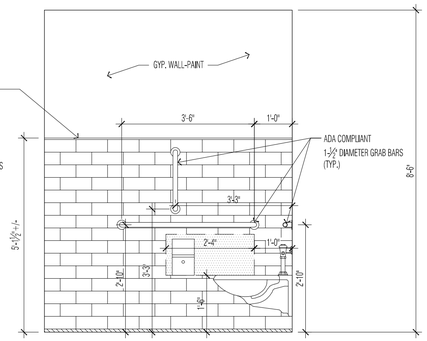
3 RESTROOM 1
ROOM 113 — 1/2"=1'-0"



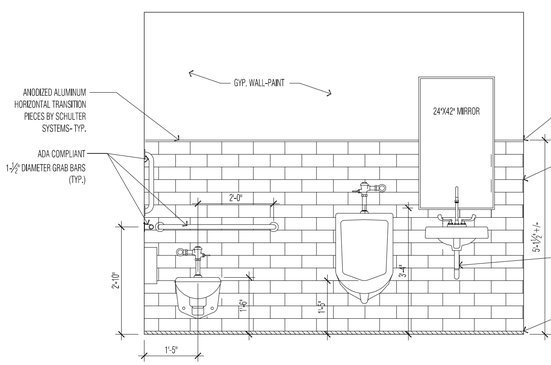
4 RESTROOM 1
ROOM 113 — 1/2"=1'-0"



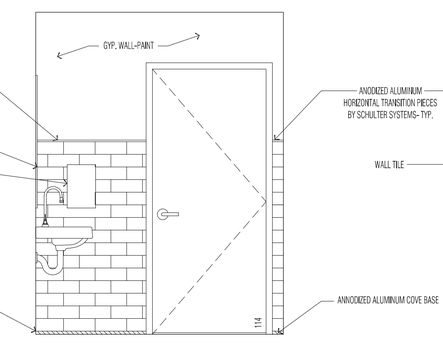
5 RESTROOM 1
ROOM 113 — 1/2"=1'-0"



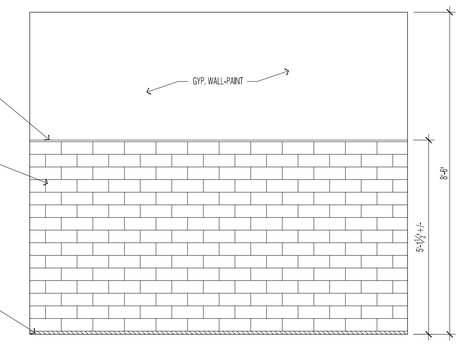
6 RESTROOM 2
ROOM 114 — 1/2"=1'-0"



7 RESTROOM 2
ROOM 114 — 1/2"=1'-0"



8 RESTROOM 2
ROOM 114 — 1/2"=1'-0"



9 RESTROOM 2
ROOM 114 — 1/2"=1'-0"

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CHECKED BY: JLO
SHEET NAME:

SHEET NO:
A7.1

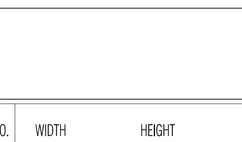
DOOR AND FRAME SCHEDULE

DOOR NO.	WIDTH	HEIGHT	THICKNESS	DOOR MAT'L	DOOR TYPE	FRAME MAT'L	FRAME TYPE	HARDWARE GROUP	FIRE LABEL	NOTES
100A	18'-0"	16'-0"	3"	METAL/GLASS	OH1	-	-	1	-	INSULATED OVERHEAD DOOR WITH PARTIAL-GLAZING SECTIONS
100B	16'-0"	16'-0"	3"	METAL/GLASS	OH2	-	-	1	-	INSULATED OVERHEAD DOOR WITH PARTIAL-GLAZING SECTIONS
100C	3'-0"	7'-10"	1 3/4"	HOLLOW MTL.	D	HOLLOW MTL.	1	10	-	
101A	16'-0"	12'-0"	3"	METAL/GLASS	OH3	-	-	1	-	INSULATED OVERHEAD DOOR WITH PARTIAL-GLAZING SECTIONS
101B	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	C	HOLLOW MTL.	1	5	-	
102	12'-0"	12'-0"	3"	METAL/GLASS	OH4	-	-	1	-	INSULATED OVERHEAD DOOR WITH PARTIAL-GLAZING SECTIONS
103	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	1	3	-	
104	3'-0"	7'-10"	1 3/4"	ALUMINUM	B	ALUMINUM	1	11	-	EXTERIOR STOREFRONT ENTRANCE
104A	3'-0"	7'-10"	1 3/4"	ALUMINUM	-	ALUMINUM	-	8	-	INTERIOR STOREFRONT ENTRY - SEE WDW. TYPE "F"
107	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	2	2	-	
109	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	-	9	-	
110	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	C	HOLLOW MTL.	1	5	-	
112A	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	B	HOLLOW MTL.	1	2	-	
112B	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	B	HOLLOW MTL.	1	2	-	
112C	3'-0"	7'-0"	1 3/4"	ALUMINUM	-	ALUMIMUM	-	11	-	EXTERIOR STOREFRONT ENTRY - SEE WDW. TYPE "G"
113	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	1	7	-	
114	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	1	7	-	
115	3'-0"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	1	4	-	
202	3'-6"	7'-0"	1 3/4"	HOLLOW MTL.	A	HOLLOW MTL.	1	6	-	

DOOR/FRAME/WINDOW TYPES

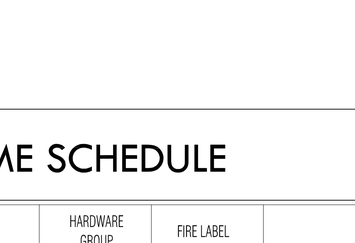
NOTES:

-FIELD VERIFY ALL OPENING DIMENSIONS PRIOR TO FABRICATING DOORS, FRAMES, AND WINDOWS.
-DOOR CONFIGURATION SHOWN FOR REFERENCE ONLY - MANUFACTURER LAYOUT MAY VARY (VERIFY)
-GLASS TYPES INDICATED ARE TYPICAL. ALL NON-TYPICAL INSTANCES ARE NOTED ON THE DOOR SCHEDULE.

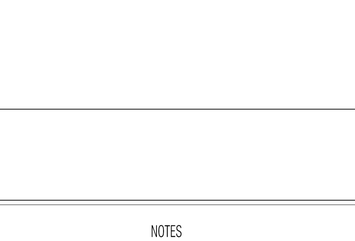


1 2

A SOLID DOOR | B FULL VISION GLASS | C PARTIAL VISION GLASS | D PARTIAL VISION GLASS



OH-1 INSULATED MTL. OVERHEAD WITH VISION PANELS



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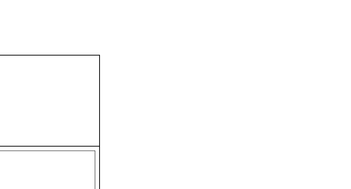
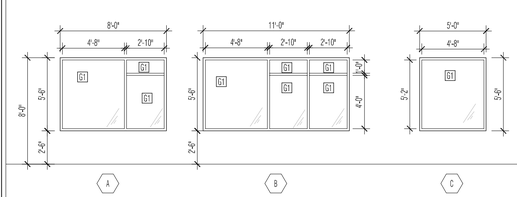
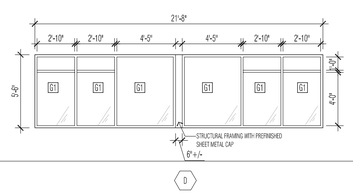


OH-3 INSULATED MTL. OVERHEAD WITH VISION PANELS

OH-4 INSULATED MTL. OVERHEAD WITH VISION PANELS



A B C



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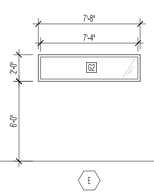

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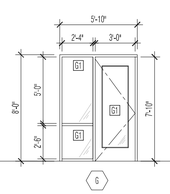

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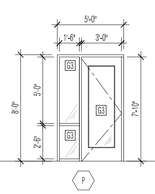
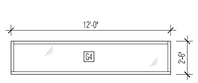


P

GLASS TYPE NOTES	
G1	1" LOW-E INSULATED VISION GLASS
G2	1" FROSTED INSULATED GLASS
G3	¼" CLEAR @ INTERIOR
G4	TRANSLUCENT POLY CARBONATE

NOTE:
ALL WINDOWS ARE PREFIN. ALUM. STOREFRONT WITH 2" FRAMES U.N.O.



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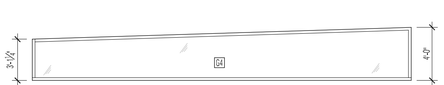

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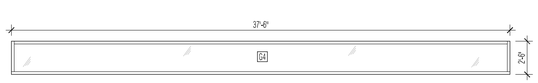

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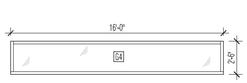

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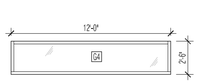

V

PLOTTED: 7-25-2019 FILE NAME: A8.1_1842.dwg

ThreeRivers PARK DISTRICT
in partnership with
Scott County

CONSULTANT:
OERTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ARCHITECT UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature
Jeffery L. Oertel
Name
15840 License #
07/25/19 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RAB
CHECKED BY: JLO

SHEET NAME:
DOOR AND WINDOW SCHEDULES

SHEET NO:
A8.1

ROOM FINISH SCHEDULE

ROOM NO.	ROOM NAME	FLOOR		BASE	WALL								CEILING			REMARKS
					NORTH		WEST		SOUTH		EAST					
		MAT'L	FINISH	MAT'L	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	MAT'L	FINISH	HEIGHT	
100	VEHICLE BAYS	CONC.	SEALED	CONC.	PLYWOOD / GYP. BRD.	PAINT/FRP	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	WOOD	PAINT	VARIES	PORTION OF NORTH WALL TO INCLUDE FRP FINISH - SEE PLAN FOR LOCATION
101	WORK - DELIVERY	CONC.	SEALED	CONC.	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	WOOD	PAINT	VARIES	
102	STORAGE	CONC.	SEALED	CONC.	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	PLYWOOD / GYP. BRD.	PAINT	WOOD	PAINT	VARIES	
103	PSO OFFICE	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
104	ENTRY VESTIBULE	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
105	WORKSPACE	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
106	CREW CHIEF	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
107	SUPERVISOR OFFICE	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
108	LOCKER ROOM	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
109	I.T. ROOM	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	PLYWOOD	--	PLYWOOD	--	PLYWOOD	--	--	"	--	
110	CORRIDOR	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
111	TIMECLOCK - VENDING	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
112	LUNCHROOM	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
112A	LUNCHROOM	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	
113	RESTROOM 1	CONC.	SEALED	ALUM. COVE	GYP BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	ACT	"	8'-6"	8'-0" GYP CEILING OVER SHOWER AREA - PAINT
114	RESTROOM 2	CONC.	SEALED	ALUM. COVE	GYP. BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	GYP. BRD.	TILE / PAINT	ACT	"	8'-6"	
115	JANITOR'S CLOSET	CONC.	SEALED	VINYL	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	GYP. BRD.	PAINT	ACT	"	8'-6"	FRP PANELS AT MOP SINK SURROUND
201	STOARGE MEZZANINE	PLYWOOD	--	WOOD	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	VARIES	
202	MECHANICAL ROOM	PLYWOOD	EPOXY PAINT	WOOD	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	WOOD	PAINT	VARIES	

ROOM FINISH NOTES

1. AT VEHICLE AREAS, PAINT ALL EXPOSED STEEL
2. ONE PAINT COLOR AT OFFICE AREAS. 2ND PAINT COLOR AT VEHICLE AREAS
3. CEILINGS AND CEILING/ROOF STRUCTURE TO BE PAINTED WHITE
4. H.M. DOORS AND FRAMES TO BE ACCENT COLOR
5. AT VEHICLE AREAS, PLYWOOD AND GYP BRD WALLS TO BE PAINTED SAME COLOR

ThreeRivers
PARK DISTRICT
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Signature

Jeffery L. Oertel
Name

15840 License #

07/25/19 Date

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DRAWN BY: RAB
CHECKED BY: JLO

SHEET NAME:
FINISH SCHEDULE

SHEET NO:
A8.2

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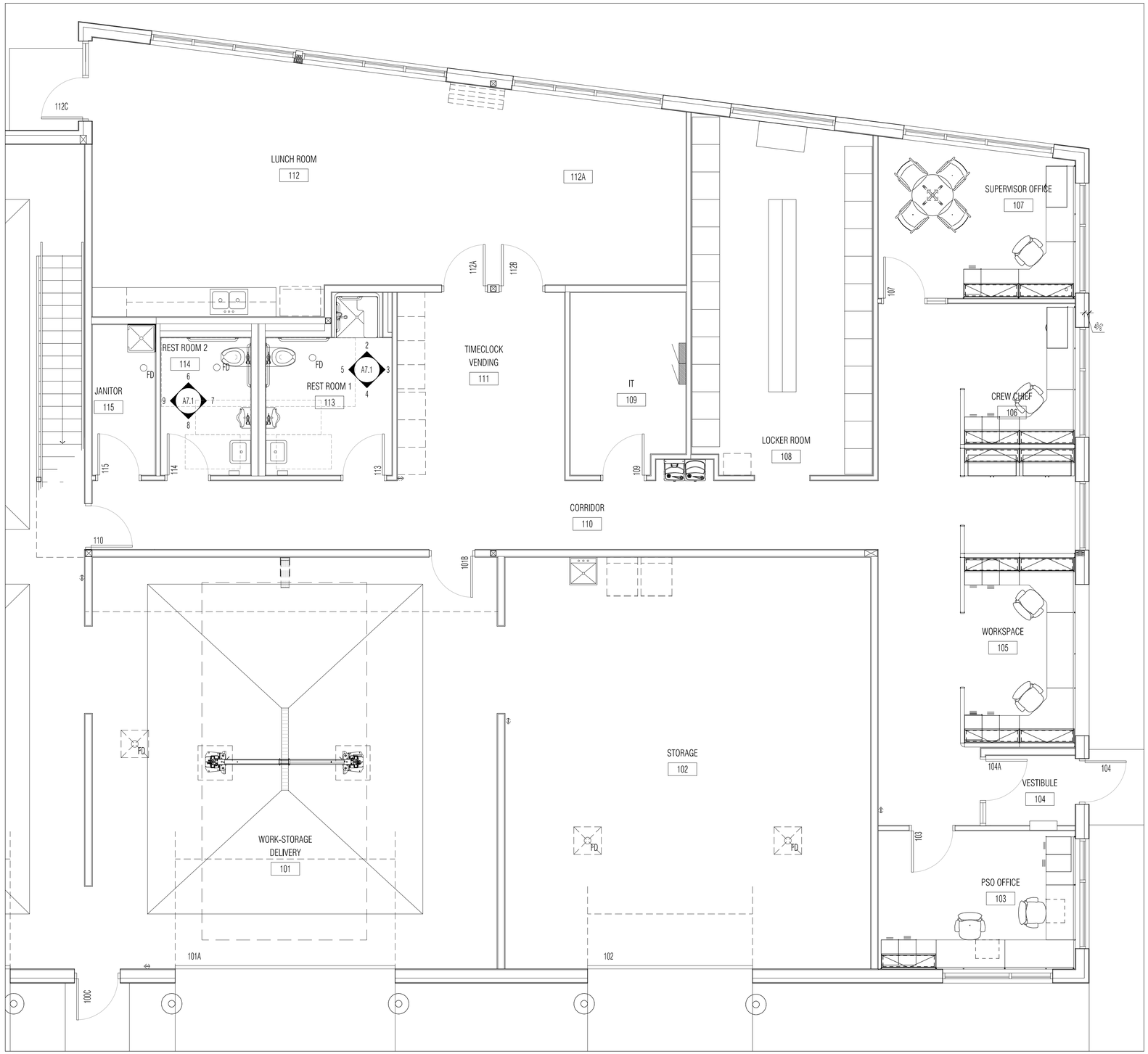

1 FURNITURE PLAN- FOR REFERENCE ONLY

MAIN FLOOR 1/4" = 1'-0"

North

PLOTTED: 7-25-2019 FILE NAME: A91_1842.dwg

ThreeRivers PARK DISTRICT

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Scott County

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CHECKED BY: JLO

SHEET NAME:

FURNITURE PLAN

SHEET NO:

A9.1

STRUCTURAL ABBREVIATIONS:

A	
ADDL	ADDITIONAL
ADJ	ADJACENT
ALT	ALTERNATE
ALUM	ALUMINUM
AR	ANCHOR ROD
ARCH	ARCHITECT
B	
BDE	BOTTOM OF DECK ELEVATION
BFE	BOTTOM OF FOOTING ELEVATION
BM	BEAM
BOT	BOTTOM
BP	BEARING PLATE / BASE PLATE
BR	BOTTOM REINFORCING
BTWN	BETWEEN
C	
CANTL	CANTILEVER
CIP	CAST IN PLACE
CGS	CENTER OF GRAVITY STRAND
CJ	CONTROL JOINT
CJP	COMPLETE JOINT PENETRATION
CL	CENTER LINE
CLR	CLEAR
CMU	CONCRETE MASONRY UNIT
COL	COLUMN
CONC	CONCRETE
CONN(S)	CONNECTION(S)
CONST	CONSTRUCTION
CONT	CONTINUOUS
D	
d	NAIL DIAMETER
db	BAR DIAMETER
DBA	DEFORMED BAR ANCHOR
DBL	DOUBLE
DEG	DEGREE
DEMO	DEMOLITION
DF	DOUGLAS FIR-LARCH
DIA	DIAMETER
DIAG	DIAGONAL
DIM	DIMENSION
DL	DEAD LOAD

E	
EA	EACH
EF	EACH FACE
EL	ELEVATION
ELEC	ELECTRICAL
ELEV	ELEVATOR
EJ	EXPANSION JOINT
EMBED	EMBEDMENT
EQ	EQUAL
EQUIP	EQUIPMENT
ES	EACH SIDE
EW	EACH WAY
E-W	EAST - WEST DIRECTION
(E)	EXISTING
EXP	EXPANSION
F	
FDN	FOUNDATION
FD	FLOOR DRAIN
FFE	FINISHED FLOOR ELEVATION
FLR	FLOOR
FS	FOOTING STEP
FT	FEET
FTG	FOOTING
FV	FIELD VERIFY
G	
GA	GAGE/GAUGE
GALV	GALVANIZED
GB	GRADE BEAM
GC	GENERAL CONTRACTOR
GLB	GLUE LAMINATED BEAM
GR	GRADE
GSN	GENERAL STRUCTURAL NOTES
GWB	GYPSUM WALL BOARD

H	
HK	HOOK
HORIZ	HORIZONTAL
HSA	HEADED STUD ANCHOR
HSS	HOLLOW STRUCTURAL SHAPE
HT	HEIGHT
I	
ID	INSIDE DIAMETER
INCL	INCLUDE
ISF	INSIDE FACE
J	
JT	JOINT
JBE	JOIST BEARING ELEVATION
K	
K	KIPS
KLF	KIPS PER LINEAL FOOT
KSF	KIPS PER SQUARE FOOT
KSI	KIPS PER SQUARE INCH
KO	KNOCK OUT
L	
LB(S)	POUND(S)
LL	LIVE LOAD
LLH	LONG LEG HORIZONTAL
LLV	LONG LEG VERTICAL
LONG	LONGITUDINAL
LSL	LAMINATED STRAND LUMBER
LSH	LONG SIDE HORIZONTAL
LSV	LONG SIDE VERTICAL
LWT	LIGHT WEIGHT
LVL	LAMINATED VENEER LUMBER

M	
MAX	MAXIMUM
MECH	MECHANICAL
MEP	MECHANICAL, ELECTRICAL & PLUMBING
MEZZ	MEZZANINE
MFR	MANUFACTURER
MIN	MINIMUM
MISC	MISCELLANEOUS
MSR	MACHINE STRESS RATED
MTL	METAL
N	
NIC	NOT IN CONTRACT
N-S	NORTH - SOUTH DIRECTION
NTS	NOT TO SCALE
NWT	NORMAL WEIGHT
O	
OC	ON CENTER
OD	OUTSIDE DIAMETER
OSF	OUTSIDE FACE
OPNG	OPENING
OPP	OPPOSITE
O/O	OUT TO OUT
P	
PAF	POWER ACTUATED FASTENER
PC	PRECAST CONCRETE
PL	PLATE
PLF	POUNDS PER LINEAL FOOT
PLYWD	PLYWOOD
PRE FAB	PREFABRICATED
PROJ	PROJECTION
PSF	POUNDS PER SQUARE FOOT
PSI	POUNDS PER SQUARE INCH
PSL	PARALLEL STRAND LUMBER
PT	POST TENSIONED

Q	
QTY	QUANTITY
R	
R	RADIUS
RD	ROOF DRAIN
REF	REFERENCE
REINF	REINFORCEMENT/REINFORCING
REQD	REQUIRED
REV	REVISION
RO	ROUGH OPENING
RSS	RUGGED STRUCTURAL SCREW
RTU	ROOF TOP UNIT
S	
SB	SOIL BORING
SC	SLIP CRITICAL
SCHED	SCHEDULE
SER	STRUCTURAL ENGINEER OF RECORD
SF	SQUARE FOOT
SIM	SIMILAR
SL	SNOW LOAD
SOG	SLAB ON GRADE
SPA	SPACES
SPEC	SPECIFICATION
SPF	SPRUCE PINE FIR
SS	STAINLESS STEEL
SSLT	SHORT-SLOT LOAD TRANSVERSE
STD	STANDARD
STIFF	STIFFENER
STL	STEEL
STRUCT	STRUCTURE / STRUCTURAL
SYM	SYMMETRICAL
SYP	SOUTHERN YELLOW PINE

T	
T/G	TONGUE AND GROOVED
TBE	TOP OF BEAM ELEVATION
TDE	TOP OF DECK ELEVATION
TEMP	TEMPORARY
TFE	TOP OF FOOTING ELEVATION
TGBE	TOP OF GRADE BEAM ELEVATION
TPCE	TOP OF PILE CAP ELEVATION
TPCPE	TOP OF PRECAST PLANK ELEVATION
TPE	TOP OF PIER ELEVATION
TR	TOP REINFORCING
TRANS	TRANSVERSE
TSE	TOP OF SHEATHING ELEVATION
TSE	TOP OF SLAB ELEVATION
TSE	TOP OF SUBFLOOR ELEVATION
TWE	TOP OF WALL ELEVATION
TYP	TYPICAL
U	
UNO	UNLESS NOTED OTHERWISE
URM	UNREINFORCED MASONRY
V	
VERT	VERTICAL
W	
W/	WITH
W/O	WITHOUT
WD	WOOD
WF	WIDE FLANGE
WL	WIND LOAD
WP	WORK POINT
WT	WEIGHT
WWF	WELDED WIRE FABRIC

SHEET LIST

SHEET #	SHEET NAME
S001	LEGEND SHEET
S002	GENERAL STRUCTURAL NOTES
S003	GENERAL STRUCTURAL NOTES
S201	FOUNDATION PLAN
S202	MEZZANINE FRAMING PLAN
S203	ROOF FRAMING PLAN
S401	TYPICAL SCHEDULES AND DETAILS
S402	TYPICAL SCHEDULES AND DETAILS
S403	STEEL SCHEDULES AND DETAILS
S404	WOOD WALL SCHEDULES AND DETAILS
S405	WOOD WALL SCHEDULES AND DETAILS
S701	FRAMING DETAILS
S702	FRAMING DETAILS

MARKS AND SYMBOLS LEGEND:

MARKS:

B1001	CONCRETE BEAM MARK NUMBER	MC1	MASONRY COLUMN MARK NUMBER
BP1	BEARING / BASE PLATE MARK NUMBER	MF1	MOMENT FRAME MARK NUMBER
BRF1	BRACE FRAME MARK NUMBER	P1	PIER MARK NUMBER
BR1	MILD STEEL BOTTOM REINFORCING MARK NUMBER	PC1	PILE CAP MARK NUMBER
C1	COLUMN MARK NUMBER	PTB101	POST TENSIONED CONCRETE BEAM MARK NUMBER
CC1	CONCRETE COLUMN MARK NUMBER	RD1	ROOF DECK MARK NUMBER
D1	STEEL DECK MARK NUMBER	S1	SLAB MARK NUMBER
DC1	DROP CAPITAL MARK NUMBER	SC1	STEEL COLUMN MARK NUMBER
DP1	DRILLED PIER MARK NUMBER	SR1	STUD RAIL REINFORCING MARK NUMBER
EP1	EMBEDDED PLATE MARK NUMBER	SW1	SHEAR WALL MARK NUMBER
F1	SPREAD FOOTING MARK NUMBER	T1	TRUSS MARK NUMBER
GB1	GRADE BEAM MARK NUMBER	TR1	MILD STEEL TOP REINFORCING MARK NUMBER
H1	HEADER MARK NUMBER	W1	WALL MARK NUMBER
HCP	HOLLOW CORE PLANK	WC1	WOOD COLUMN MARK NUMBER
HD1	HOLD DOWN MARK NUMBER	WF1	WALL FOOTING MARK NUMBER
J10	JOIST MARK NUMBER	WO1	WEB OPENING
L1	LINTEL MARK NUMBER	WSW1	WOOD SHEAR WALL MARK NUMBER
LC1	LIGHT GAGE COLUMN MARK NUMBER		

GENERAL SYMBOLS:

APPROXIMATE LOCATION OF DRAIN TILE

MATCH LINE

LINE OF DEMOLITION

(?'-?") (?'-?") SLAB STEP LOCATION WITH ELEVATIONS

SLAB STEP LOCATION

CHANGE IN SLAB SLOPE

CHANGE IN SLAB THICKNESS

1 KEYNOTE MARK NUMBER

? NEW BUILDING GRID LINE

? EXISTING BUILDING GRID LINE

ELEVATION MARKER

SHADED AREA INDICATES CUT THROUGH EXISTING CONSTRUCTION

SHADED AREA INDICATES PROJECTION OF EXISTING CONSTRUCTION

W1 WALL MARK NUMBER OR WALL TYPE

APPROXIMATE LOCATION OF UTILITY PIPE PENETRATION THROUGH FOUNDATION WALL

FS FOOTING STEP LOCATION

SB1 APPROXIMATE LOCATION OF SOIL BORING

COMPRESSION PILE

TENSION / COMPRESSION PILE

TEST PILE

SPAN DIRECTION OF ELEMENT

EXTENT OF ELEMENT

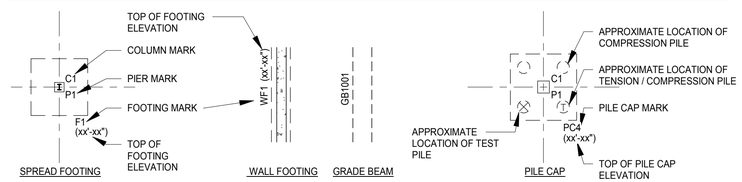
CONTINUOUS EXTENT OF ELEMENT

Sxxx DETAIL CALLOUT

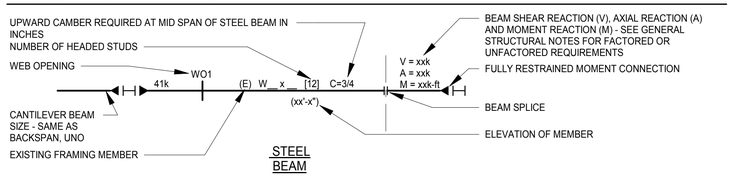
Sxxx ELEVATION CALLOUT

PLAN SYMBOLS LEGEND:

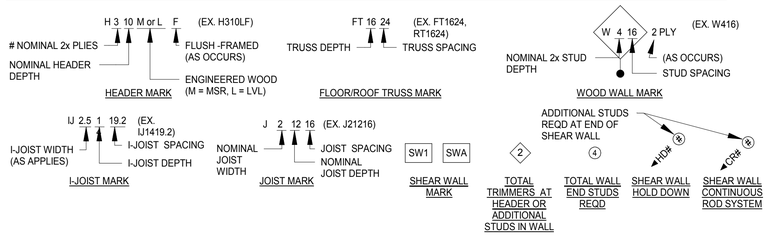
FOUNDATION SYSTEM:



STEEL FRAMING SYSTEM:



WOOD / LIGHT GAUGE FRAMING SYSTEM:



ThreeRivers PARK DISTRICT

in partnership with

Scott County

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SEE STRUCTURE.

REVISION / ISSUE:

NO.	DATE	DESCRIPTION
	07/24/19	CONSTRUCTION DOCUMENTS

PROJECT NAME:

CLEARY LAKE REGIONAL PARK MAINTAINANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE:

ROBERT C CHILSON
NAME

40856 LICENSE #

07/24/19 DATE

PROJECT NUMBER: 19.483.0

DATE OF ISSUE: 07/24/19

DRAWN BY: DJL

CHECKED BY: ED

SHEET NAME:

LEGEND SHEET

SHEET NO:

S001

TYPICAL NOTES:
These notes specify the requirements for the design represented in these documents. The construction and materials shall comply with all the pertinent codes and references, plans, and details, including (but not limited to) those shown in architectural, civil, mechanical and electrical drawings.

The contractor shall verify all dimensions and existing conditions in the field that affect construction prior to commencing work on the affected element or shop drawing submittals. Resolve any discrepancies with the architect prior to construction.

The contract structural drawings and specifications represent the completed structure. The contractor is responsible for bracing and shoring (without overstressing) all structural elements as necessary at any stage of construction until completion of the project. The Structural Engineer is not responsible for the contractor's means, methods, sequences or procedures of construction. Contractor shall recognize and consider effects of thermal movements of structural elements during construction period.

The contractor is solely responsible for site safety including all temporary precautionary measures and safety programs. Site observation visits by the Structural Engineer do not include review of the contractor's safety precautions.

Refer to architectural, mechanical and electrical drawings for locations, elevations, dimensions, and details of sleeves, inserts, openings, recesses, curbs, housekeeping pads, etc. that are not shown on the structural drawings and do not damage structural members.

Information shown in the structural drawings regarding existing conditions represents the current and general field conditions related to the new work, to the best of our knowledge. Report all discrepancies (unforeseen conditions) to the Architect for resolution prior to performing related new work.

Requests for information shall be submitted in writing and shall reference the part of the construction documents that is in question.

SPECIAL INSPECTIONS:
Special inspections required by the building code and these documents shall be provided in addition to inspections to be performed by the City in which the Project is located.

Contractor shall read and understand their duties in the specification and under the building code for special inspections and coordinate as necessary the owner's responsibilities.

The special inspectors shall be provided by the Owner and shall only use structural drawings and approved shop drawings.

Special inspection reports are to be submitted promptly and within 24 hours to the Structural Engineer of Record and Contractor from the time when inspections are performed.

The general contractor shall provide timely notice (minimum 24 hours) to the special inspector and sufficient time for the inspector to perform their inspection.

For a schedule of Special Structural Inspections required by the building code for this project, see the Special Inspection Schedule.

STRUCTURAL TEST AND SPECIAL INSPECTION SCHEDULE:

		Continuous	Periodic	None
1.	STEEL CONSTRUCTION: Section 1705.2.1 and Table 1705.2.2			
1.1	Fabricator Documentation - Note (1)	☐	■	☐
1.2	High Strength Bolting-Bearing Material	☐	■	☐
1.3	High-Strength Bolting-Slip-Critical and Material	☐	☐	■
1.4	Steel Material, Seismic - Section 1705.11.1	☐	☐	■
1.5	Welds: Full and Part Pen and Multi-Pass Fillet	■	☐	☐
1.6	Welds: Single Pass Fillet for All Sections	☐	■	☐
1.7	Frame Joint Detail Compliance	☐	■	☐
2.	CONCRETE CONSTRUCTION: Section 1705.3 Table 1705.3			
2.1	Member Shape and Size Compliance in Formwork	☐	■	☐
2.2	Reinf Steel and PT Tendons Size, Quantity and Placement	☐	■	☐
2.3	Weldability of Reinforcing and Welds	☐	■	☐
2.4	Anchors in Concrete	■	☐	☐
2.5	Use of Required Mix Design	☐	■	☐
2.6	Sample for Specimens and Tests	■	☐	☐
2.7	Placement of CIP Concrete and Shotcrete	■	☐	☐
2.8	Curing Compliance	☐	■	☐
2.9	Strength for Stressing PT Tendons	☐	■	☐
2.10	Prestressing Force Application	■	☐	☐
2.11	Grouting Bonded Tendons - Seismic	☐	☐	■
2.12	Strength for Formwork Removal	☐	■	☐
2.13	Erection of Precast Members	☐	■	☐
3.	MASONRY CONSTRUCTION: Section 1705.4 TMS 402/ACI 530/ASCE 5; Note 2			
3.1	Level B: Section 1.18.2 Table 1.18.2			
3.1.1	Grout Placement and Sampling	☐	☐	■
3.1.2	Welding Reinforcing	☐	☐	■
3.1.3	Other Inspection Tasks	☐	☐	■
3.2	Level C: Section 1.18.3 Table 1.18.3			
3.2.1	Open Cores and Grout Placement	☐	☐	■
3.2.2	Embedded Anchors	☐	☐	■
3.2.3	Welding Reinforcing	☐	☐	■
3.2.4	Specimen and Prism Sampling	☐	☐	■
3.2.5	Other Inspection Tasks	☐	☐	■
4.	WOOD CONSTRUCTION: Section 1705.5			
4.1	Fabricator, Prefab Trusses and Panels, Note 1	☐	☐	■
4.2	High Load Diaphragms - Table 2306.2 (2)	☐	☐	■
5.	SOILS: Section 1705.6 and Table 1705.6			
5.1	Bearing Material, Capacity and Depth	☐	■	☐
5.2	Compacted Fill Compliance With Soils Report	■	☐	☐
6.	PILE FOUNDATIONS: Section 1705.7 and Table 1705.7			
6.1	Pile Material, Size and Length	☐	☐	■
6.2	Test for Pile Capacity	☐	☐	■
6.3	Observation, Compliance and Records per Pile	☐	☐	■
7.	PIER FOUNDATIONS: Section 1705.8 and Table 1705.8			
7.1	Observation, Compliance and Records per Pier	☐	☐	■

Notes:
1. When the fabricator does not meet the requirements of 1704.2.5.2 and where applicable the exception in 1705.2, Special Inspection in the Fabricator's shop is required.
2. Empirically designed masonry is excluded.

SHOP DRAWINGS:

Submit shop drawing schedule with construction schedule that includes consideration for review period. See specification for additional information.

General contractor shall submit shop drawings in digital format for structural review. Digital drawing shall meet the following requirements.
1. Adobe extension (.pdf)
2. All pages are rotated, printed to scale.
3. All transmittals shall be located as the first page of the submittal or as a separate file within one digital package.
4. Contractor digital review comments and their digital stamp shall be attached. Our review will not occur until the contractor has reviewed, coordinated with other trades and provided shop stamp.
5. MBJ will mark-up the digital set in red and return a digital file via email, ftp site or other means.

DEFERRED SUBMITTALS:
The following items shall be issued as deferred submittals per IBC:
Metal Stairs, handrails and guardrails

All engineering design provided by others and submitted for review shall bear the certification stamp and signature of a qualified professional engineer who is licensed in the state where the project is located. Under no circumstances will MBJ review shop drawings that are considered to be scanned/copied construction document submittals. The detailer shall produce and submit original documents for review.

All items issued as deferred submittals shall be issued a minimum of 30 days prior to installation and shall not be installed until their design and submittal documents have been reviewed for general conformance to the drawings by the general contractor, the engineer of record and the building official. A copy of the deferred submittal shall be forwarded to the building official after the engineer of record has reviewed the documents and prior to the erection of the deferred submittal items.

DESIGN CODES AND STANDARDS:
2012 International Building Code, as amended and adopted by Minnesota.

MATERIAL PROPERTIES:

Reinforcing Steel (Fy):		
Typical	60,000 psi	ATSM A615 Grade 60
Weldable	60,000 psi	ASTM A706 Grade 60
Cast-in-Place Concrete (f'c) at 28 days, u.n.o.:		
Footings	4,000 psi	
Slabs on Grade	4,000 psi	
Exterior Concrete	4,000 psi	
All Concrete not otherwise noted	4,000 psi	
Structural Steel (Fy):		
Angles, Channels, Plates, and Bars	36,000 psi	ASTM A36
Rectangular HSS	46,000 psi	ASTM A500, Grade B
Structural Fasteners:		
Typical High-Strength Bolts	105,000 psi	ASTM A325
Carbon Steel, Threaded Rods	36,000 psi	ASTM A36
Anchor Rods, Grade 36 U.N.O.	36,000 psi	ASTM F1554
SAWN LUMBER:		
Spruce-Pine-Fir (SPF) No. 2 or better: (Studs and Built-up Posts)	Fb 875 psi Fc 1150 psi parallel to grain Fc 425 psi perpendicular to grain E 1,400,000 psi	
STRUCTURAL COMPOSITE LUMBER:		
Laminated Veneer Lumber (LVL): (Beams and Headers) (1 3/4" x Depth)	Fb 2900 psi Fv 285 psi Fc 750 psi perpendicular to grain E 2,000,000 psi	
Parallel Strand Lumber (PSL): (Columns and Posts)	Fb 2400 psi tabulated Fc 2500 psi parallel to grain E 1,800,000 psi	
Laminated Strand Lumber (LSL): (Rim Board)	Fb 1700 psi Fv 410 psi Fc 750 psi perpendicular to grain E 1,350,000 psi	
Oriented Strand Board (OSB): (APA Rated Rim Board)	Fbe 600 psi Fve 270 psi Fce 550 psi perpendicular to grain E 550,000 psi	

DESIGN LOADS:
LATERAL LOADS:

Risk Category:	II
Wind Loads:	
Primary Frame Wind Data:	
Basic Wind Speed:	V ult = 115 mph V asd = 90 mph
Exposure Category:	C
Internal Pressure Coefficient (Gcpi):	+0.18 or –0.18
Components and Cladding Wind Loads:	
Exterior Component/Cladding:	Supplier to develop based on code criteria and indicate on shop drawings.
Seismic Loads:	
Primary Seismic Data:	No design required

GRAVITY LOADS:

Dead Load:	
Roof:	17 psf
Floor:	14 psf
Snow Load:	
Ground Snow Load, Pg:	50 psf
Flat-Roof Snow Load, Pf:	35 psf
Snow Exposure Factor, Ce:	1.0
Snow Load Importance Factor, I:	1.0
Thermal Factor, Ct:	1.0
Unbalanced/Drift Snow Load:	Refer to plan, U.N.O.
Roof Live Load:	
Live Load, (reducible):	20 psf
Floor Live Loads:	
Mezzanine Loads, (Storage):	125 psf

FOUNDATIONS:
Refer to Geotechnical report number 01-20471 by AET, dated 06/27/2019.

The contractor shall verify the location of all existing and new underground utilities and tanks prior to beginning excavation.

For underground utilities adjacent to foundations and through foundations reference drawings for typical detail showing step footings below utilities as required to avoid undermining of structure by utilities.

CONVENTIONAL FOOTINGS:
Footings are designed for a maximum allowable soil bearing pressure of 3,000 pounds per square foot on undisturbed natural soil or compacted engineered fill. Soil bearing pressure is to be verified in the field during construction by a qualified Geotechnical Engineer.

The quality of the bedrock shall be explored (by the owner's geotechnical engineer) for the presence of soil filled seams at each column location. This shall be accomplished by drilling a 1 1/2" diameter test hole into the bedrock at each footing location prior to the placing of concrete. The depth of test hole will depend of the quality of the exposed rock, but shall not be less than 6'-0" below the bottom of the footing.

All topsoil, fill, organic, and/or other unsuitable bearing material shall be removed below the footings and/or within the building area to the depths indicated in the geotechnical engineering report and extent of removal shall be field verified by the Geotechnical Engineer.

All excavations shall be observed by a qualified Geotechnical Engineer to verify removal of all unsuitable material, and confirm the proper preparation of bearing conditions. Rock excavation for individual footings is not expected to exceed five foot depth, U.N.O. No mass excavation is anticipated. Blasting is not permitted.

For footings that do not bear on natural undisturbed soil, extend engineered fill laterally beyond bottom edge of footing per recommendations in the geotechnical report.

Foundation and retaining walls shall be back filled with free draining fill approved by the Geotechnical Engineer. Provide drainage board and perforated pipe as required by the contract documents and verify with architect and civil engineer.

Backfill equally on both sides of foundation walls to prevent overturning or lateral wall movement, or brace as necessary.

For stepping of wall footings reference drawings for detail.

REINFORCED CONCRETE:
The detailing, fabrication and erection of all reinforcing shall be done in accordance with the latest edition of ACI-315, "Manual of Standard Practice for Detailing Reinforced Concrete Structures and ACI-318, "Building Code Requirements for Structural Concrete."

All reinforcing bars are deformed and continuous, unless noted otherwise. Refer to drawings for reinforcing lap length schedule.

Provide suitable wire spacers, chairs, etc. for support of reinforcing steel in proper position while placing concrete. All bars shall be tied to prevent displacement while placing concrete. All chairs and slab bolsters shall be plastic or steel with plastic tips. When reinforcing steel is epoxy coated or p/t tendons are fully encapsulated, all chairs and slab bolsters shall be epoxy coated or plastic and all support bars shall be epoxy coated. Chairs are to be stable and resist tipping.

The fabricator shall submit a complete list of accessories and placing details with the shop drawings.

No horizontal construction joints shall be placed in beams, joists, or slabs, unless shown on drawings.

Locate vertical construction joints in beams and slabs at central one third of span. Refer to drawings for details. Submit proposed construction joint locations to the Structural Engineer of Record for review prior to placement of concrete. Where new concrete is placed against existing concrete, the existing concrete shall be roughened to a minimum 1/4" amplitude.

Refer to drawings and ACI 318 Chapter 6 for placement guidelines of embedded pipes, sleeves, and conduits. Conduits are not permitted in slabs 3 inches or less in thickness.

Provide a 3/4 inch chamfer for all exposed concrete corners. See Architectural drawings for details and additional requirements.

Formwork and all shoring for flatwork shall be left in place until the concrete reaches at least 75 percent of the 28-day compressive strength. Design of shoring and reshoring is the responsibility of the contractor and shall conform to ACI 347–04 and ACI 347.2R-05.

Aluminum conduit, aluminum sleeves and aluminum embeds are not permitted in concrete.

Calcium chloride is not permitted as a concrete additive.

Concrete Cover on Reinforcing:

Topping Slab:	3/4" clear top
Slab on Grade:	upper third of slab
Concrete covers are intended to meet the requirements of the IBC 2012 Section 722.2.3 prescriptive fire protection.	
Footings and Caissons:	3" clear bottom and sides 2" clear top
Walls:	#5 and smaller 1 1/2" clear earth or weather face #6 and greater 2" clear earth or weather face 3/4" interior face
Columns and Beams:	1 1/2" clear to ties or stirrups
Joists:	1" clear top 3/4" clear bottom and sides
Slabs:	1" clear top 3/4" clear bottom carbonate aggregate 1" clear bottom siliceous aggregate

CONCRETE SLABS ON GRADE:
Slabs on grade shall be place in lane fashion.

The control or construction joints shall be placed as shown on the drawings. The joints shall align with the column grids and be spaced as noted below:

Exterior slabs:	24 times slab thickness, maximum;
Interior slabs:	36 times slab thickness, maximum;
Interior slabs with carpeting:	48 times slab thickness, maximum.

The panels formed by control or construction joints shall not be "L" shaped and a rectangular panel's aspect ratio shall not exceed 1.5.

Refer to the drawings for the typical slab on grade construction and saw cut control joint detail. Control and construction joints must be continuous and not offset.

Refer to drawings for detail of isolation diamonds or circles at columns.

Refer to drawings for reinforcing at re-entrant corners. Bend bars as necessary at obstructions.

Refer to the specification for the existence, type, and thickness of interior ground vapor retarder. Locate a vapor retarder directly beneath the slab on grade on top of a 6 inch compactable granular base. Refer to the specification for requirements for the compactable granular base.

Mechanically vibrate concrete around trench drains, floor ducts, construction joint dowels, loading docks, architectural features and other embedded items.

Refer to the specification for slab on grade pre-pour meeting.

Refer to the specification for acceptable methods of curing the concrete.

Refer to flooring manufacturer's specification for levelness, flatness and curing of concrete slabs on grade to receive special architectural floor finishes.

STRUCTURAL STEEL:
Structural steel shall be detailed, fabricated and erected in compliance with AISC Specification for the design, fabrication, erection of structural steel for building, and Code of standard practice, and OSHA steel erection standards.

All beams and girders shall be cambered at mid-span as indicated on the structural drawings. The cambers indicated shall be present in the beam in its erected position after completion of the end connections and shall be verified prior to placing concrete. Cambering tolerances shall be (-0", +1/2"). No center point cambering allowed.

Splicing structural members where not detailed on the drawings is prohibited without prior approval of the structural engineer.

Modification of structural steel members in the field is not allowed without written approval by the structural engineer.

All composite beams using the concrete slab as a compression flange are designed for unshored construction unless noted otherwise.

Anchor rods shall be minimum 3/4" diameter or as detailed in drawings.

Per Section 7.10.1 of the Code of Standard Practice For Steel Buildings and Bridges. The lateral-load-resisting system and diaphragm elements that provide for lateral strength and stability in the completed structure.

STRUCTURAL STEEL CONNECTIONS:
All steel connections are as indicated on the drawings.

WOOD FRAMING:
DIMENSION LUMBER:
With Type 3A or 3B construction, all Lumber in exterior walls shall be fire retardant treated wood.

All member sizes given in the drawings are nominal dimensions.

All lumber shall be kiln-dried, maximum moisture content 15% and grade marked according to the National Forest Products Association Regulations.

All joists (greater than 2x8) shall be supported laterally at the ends and at each support by solid blocking except where ends of joists are nailed to a header, band or rim joist or to an adjoining stud. Solid blocking shall be not less than 2" in thickness and the full depth of the joist.

Wood joists shall bear on the full width of supporting members, stud walls, beams, etc., unless otherwise noted.

Do not notch or cut joist unless approved by the engineer.

All beams and joists not bearing on supporting members shall be framed with "Simpson Strong- Tie" joist hangers or equal. Use type "LUS" (or equal) for single 2x's and double 2x's and type "UTF" for framing to trusses where required. The joist hangers shall be nailed using special nails supplied by the hanger manufacturer. Proposed nail type substitutions shall conform to the ICC report for equal or greater load capacity and shall be submitted with the ICC report to the structural engineer for written approval.

Wood headers or posts made up of 2 or more 2x's shall be spiked together per the nailing schedule.

Provide minimum 2 -2x trim studs at bearing ends of all headers. Where posts are shown on drawings, headers shall bear fully on the posts.

Wood columns shall have solid vertical blocking through the floors to the support below.

All holes drilled through studs or posts in walls shall strictly conform to the detail in the drawings.
Wood columns are not to be notched or drilled for utilities.

For walls 10'-0" and greater provide blocking at mid-height for construction stability.

All walls shall have single bottom plate and double top plate.

Double top plate splices shall lap 4'-0" and be nailed with 16 - 0.131" x 3" nails equally spaced with 1 1/2" end distance, unless noted otherwise on plan.

Unless otherwise noted, bottom plates of all exterior stud walls and interior bearing walls shall be anchored to new concrete with 1/2" diameter anchor bolts x length embedment?, at 4'-0" oc, or with equivalent anchors, as approved by the structural engineer.

All exterior lumber and all lumber in contact with concrete or masonry, or exposed to the exterior shall be treated Southern Yellow Pine. Each sill plate shall have a minimum of 2 anchor rods with an anchor rod located within 12" of each end.

All connectors in contact with treated lumber shall have corrosion protection.

For nailing/fastener schedule refer to the drawings.

STRUCTURAL COMPOSITE LUMBER:
Structural composite lumber shall be provided with member strengths as specified in the General Structural Notes.

All members shall be stamped with the manufacturer's name and/or logo, name of inspection agency and the applicable evaluation report numbers.

Structural composite lumber such as laminated veneer lumber (LVL), parallel strand lumber (PSL), and laminated strand lumber (LSL), shall be the size and type shown on the drawings, manufactured by Truss-Joist or approved equal.

LVL, PSL, and LSL shall be manufactured under a process approved by the national research board.

All LVL shall be manufactured in accordance with NER-126
All PSL shall be manufactured in accordance with NER-292
All LSL shall be manufactured in accordance with NER-481

The manufacturing process shall use a waterproof adhesive meeting the requirements of ASTM D2559. All grain shall be parallel with the length of the member.

Structural composite lumber shall be installed with a moisture content of 12% or less. The contractor shall make provisions during construction to prevent the moisture content of installed beams from exceeding 12%.

The supplier is to furnish all connection materials required to fasten members to each other and to supports, exclusive of anchors embedded in masonry or concrete, and items to be field welded to structural steel.

Complete shop drawings including an erection plan, details of each member and each connection and design notes shall be submitted for review by the architect and engineer prior to fabrication.

Shop drawings and complete structural calculations shall be certified by a qualified professional engineer licensed in the state where the project occurs.

Comply with all recommendations by the manufacturer and with approved shop drawings for the proper storage, handling, protection, installation and temporary bracing requirements of these materials.

Bear members full width of supporting member, stud walls, posts, trim studs, beams, etc.

Notching of the bearing end or the top and bottom face is not permitted.

When installing lag screws, drill a lead hole.

ThreeRivers PARK DISTRICT
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www.mjseng.com MINNEAPOLIS, MN 55402
SEE STRUCTURE.

REVISION / ISSUE: NO.	DATE	DESCRIPTION
	07/24/19	CONSTRUCTION DOCUMENTS

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTAINANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE:
ROBERT C CHILSON
NAME
40856 LICENSE #
07/24/19 DATE

PROJECT NUMBER: 19.483.0
DATE OF ISSUE: 07/24/19
DRAWN BY: DJL
CHECKED BY: ED
SHEET NAME:

GENERAL STRUCTURAL NOTES

SHEET NO:

S002

PREFABRICATED WOOD TRUSSES:
Truss Plate Manufacturer shall be a current member in good standing of the Truss Plate Institute. The Truss Fabricator shall participate in a third party quality assurance program that is approved by a code approved inspection agency or that meets the requirement of the Truss Plate Institute.

Truss Supplier shall submit shop drawings and design calculations for review.

Prior to fabrication of trusses the Truss Supplier shall submit a record copy of shop drawings and design calculations incorporating review comments. The shop drawings are certified by a qualified Professional Engineer registered in the state where the project is located. See project specification manual for additional submittal requirements.

The configuration of the web members for roof trusses shall be determined by the manufacturer in accordance with all architectural and structural criteria.

The truss shall be designed for the following minimum dead loads:

Roof: 17 psf

Floor: 14 psf

Truss spacing indicated from center to center of truss and shall not exceed 2'-0" oc

Deflection criteria: For live load deflection, provide roof L/360 and floor L/480.
For total load deflection, provide roof L/240 and floor L/360.

For floor trusses align all web members throughout a bay. The contractor shall coordinate any mechanical requirements with the truss fabricator.

Truss plate connections shall be designed in accordance with the Truss Plate Institute.

All roof truss bearing points shall be anchored with a minimum of one Simpson H1 truss anchor.

All floor truss bearing points shall be anchored with a minimum of one Simpson H2.5 truss anchor. – (seismic note)

Manufacturer shall provide design/materials and installation of all necessary blocking, bracing, and connection material to complete the installation, U.N.O.

Exact configuration of special hip, valley and intersection areas shall be determined by the Truss Supplier, unless noted otherwise on plans.

Provide all truss to truss, and truss to girder truss connection details and necessary connection materials.

Site fabricated trusses are not allowed.

Comply with all recommendations by the manufacturer and the approved shop drawings for proper storage, handling, protection, installation, and temporary bracing requirements.

Permanent bridging shall be installed in accordance with the manufacturer's specification.

Notching or cutting of trusses, top or bottom chords is not permitted.

A qualified representative of the Open Web Wood Chord Truss manufacturer shall inspect and approve the system installation prior to installing finish materials to be certain that the system is in compliance with all requirements of the shop drawings. Submit a written report summarizing the inspection and the product warranty to the owner at the completion of the product. Copy the engineer with the report.

WOOD STRUCTURAL PANELS:
Wood structural panels shall conform to the requirement of "U.S. Product Standard PS 1 for Construction and industrial Plywood", "U.S. Product Standard PS 2 Performance Standard for Wood-Based Structural-Use Panels, or "APA PRP-108 Performance Standards." Panels shall be APA Rated Sheathing, Exposure 1, of the thickness and Span Rating shown on the drawings.

Wood structural panel installation shall be in conformance with APA recommendations. Allow 1/8" spacing at panel ends and edges, unless otherwise recommended by the panel manufacturer.

All roof sheathing and sub-flooring shall be installed with face grain perpendicular to supports, except as indicated on the drawings.

Roof sheathing shall either be blocked, tongue-and-groove, or have edges supported by plywood edge clips centered between roof framing elements.

When roof sheathing is nailed directly to blocking, the blocking shall be nailed to support members with a minimum of 16d nails at 4" oc.

Sub-flooring sheathing shall have tongue and groove joints or be supported by blocking.

Sub-flooring panels shall be field glued to the framing using adhesives meeting APA Specifications AFG-O1 or ASTM D3498.

For nailing of wall panels to framing refer to the drawings or nailing schedule in the drawings.

WOOD FASTENERS – NAILING:
Framing nail sizes specified on the drawings are based on the following specification U.N.O.:

Size	Length	Diameter
6d common	2"	0.113"
8d common	2 1/2"	0.131"
10d common	3"	0.148"
12d common	3 1/4"	0.148"
16d common	3 1/2"	0.162"

Size	Length	Diameter
6d box	2"	0.099"
8d box	2 1/2"	0.113"
10d box	3"	0.128"
16d box	3 1/4"	0.135"

Size	Length	Diameter
6d cooler	1 7/8"	0.092"
8d cooler	2 3/8"	0.113"

All framing nails shall conform to ASTM F667, "Standard Specification for Power Driven Fasteners: Nails, Spikes and Staples" and NER-272 "Power Driven Staples and Nails for Use in All Types of Building Construction". Cooler nails shall comply with ASTM C 514.

Refer to nailing schedule in the drawings for nail size and spacing at a specified condition.

Nails shall be identified by labels attached to their containers that show the manufacturer's name and NES report number, nail shank diameter, and length. Submit this information prior to framing.

If the contractor proposes the use of alternate nails, they shall submit prior to construction nail specifications with certified calculations showing structural equivalence to the engineer for review and approval.

Nails fastening APA rated plywood sheathing shall be driven flush to the face of sheathing with no counter sinking permitted. Renail sheathing as necessary to comply.

ThreeRivers PARK DISTRICT

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Scott County

CONSULTANT:

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www.mjseng.com MINNEAPOLIS, MN 55402
SEE STRUCTURE.

REVISION / ISSUE:

NO.	DATE	DESCRIPTION
	07/24/19	CONSTRUCTION DOCUMENTS

PROJECT NAME
CLEARY LAKE REGIONAL PARK MAINTAINANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

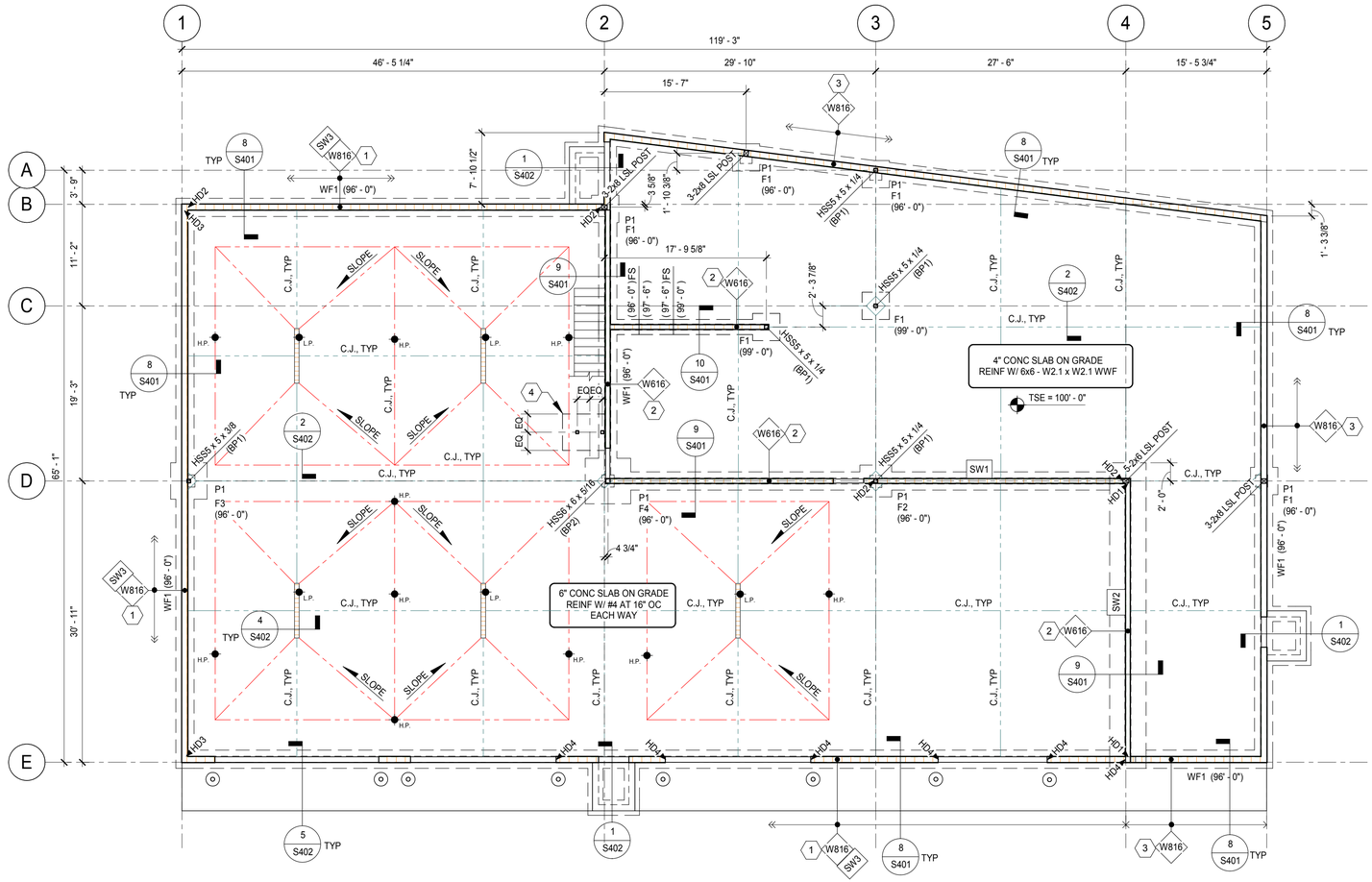
I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE:
ROBERT C CHILSON
NAME
40856 LICENSE #
07/24/19 DATE

PROJECT NUMBER: 19.483.0
DATE OF ISSUE: 07/24/19
DRAWN BY: DJL
CHECKED BY: ED

SHEET NAME:
GENERAL STRUCTURAL NOTES

SHEET NO:
S003



1 FOUNDATION PLAN

1/8" = 1'-0"

REFERENCE NOTES:

1. SEE SHEET S001 FOR SHEET INDEX, TYPICAL ABBREVIATIONS AND LEGENDS.
2. SEE SHEET S002 FOR GENERAL STRUCTURAL NOTES.
3. SEE SHEET S301 FOR BUILDING ELEVATIONS.
4. SEE SHEET S401 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
5. SEE SHEET S402 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
6. SEE SHEET S403 FOR WOOD SCHEDULES AND TYPICAL DETAILS.
7. SEE SHEET S500 SERIES FOR FOUNDATION AND CONCRETE FRAMING DETAILS.
8. SEE SHEET S700 SERIES FOR FRAMING DETAILS.

PLAN NOTES (UNLESS NOTED OTHERWISE):

1. PROJECT DATUM ELEVATION, SEE CIVIL AND ARCHITECTURAL DRAWINGS.
2. TOP OF FOOTING ELEVATION (TFE) = 98' - 0", UNLESS NOTED OTHERWISE ON PLAN AS (XX'-XX").
3. ALL FOOTINGS ARE CENTERED UNDER WALLS AND COLUMNS.
4. SEE TYPICAL FOUNDATION DETAILS FOR UTILITY PENETRATIONS THROUGH FOUNDATIONS. SEE PLAN FOR APPROXIMATE LOCATIONS. VERIFY LOCATIONS AND ELEVATIONS WITH MECHANICAL DRAWINGS.
5. TOP OF PIER ELEVATION (TPE) = 99' - 0", UNLESS NOTED OTHERWISE ON PLAN AS (XX'-XX").
6. TOP OF SLAB-ON-GRADE ELEVATION (TSE) = 100' - 0" AT HIGH POINT, 99' - 9 3/4" AT LOW POINT.
7. PROVIDE THICKENED SLAB-ON-GRADE UNDER NON-LOAD-BEARING MASONRY WALLS AND STAIR STRINGER BASES AS SHOWN IN THE TYPICAL DETAILS. SEE ARCHITECTURAL DRAWINGS FOR EXTENT AND LOCATIONS OF THESE ELEMENTS.
8. FOR SLAB JOINT LAYOUTS, SEE PLANS AND GENERAL STRUCTURAL NOTES FOR CRITERIA. FOR TYPICAL CONTROL AND CONSTRUCTION JOINTS SEE TYPICAL SLAB JOINTING DETAILS.
9. SEE ARCHITECTURAL DRAWINGS FOR ADDITIONAL INFORMATION, INCLUDING LOCATIONS AND DIMENSIONS OF RAMPS, SLAB SLOPES, SLAB STEPS AND SLAB DEPRESSIONS.
10. VERIFY SIZE, LOCATION AND INVERT ELEVATIONS FOR ALL UTILITIES, SITE STRUCTURES, SUMPS AND DRAINS WITH CIVIL, MECHANICAL, ELECTRICAL AND ARCHITECTURAL DRAWINGS.
11. SEE CIVIL / LANDSCAPE DRAWINGS FOR PAVING AND SITE DETAILS AT THE BUILDING EXTERIOR.

KEYNOTES:

1. 8" STUD WALLS ARE DESIGNED USING LAMINATED STRAND LUMBER (LSL) STUDS AT 16" OC.
2. 6" STUD WALLS ARE DESIGNED USING SPRUCE PINE FIR #2 (SPF) STUDS AT 16" OC.
3. 8" STUD WALLS ARE DESIGNED USING SPRUCE PINE FIR #2 (SPF) STUDS AT 16" OC.
4. 4'-0" x 6'-0" x 1'-0" THICKENED SLAB WITH #5 AT 12" OC EACH WAY BOTTOM TO SUPPORT STAIR POSTS. THICKENED SLAB IS CENTERED ON POSTS.

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SEE STRUCTURE.

REVISION / ISSUE:

NO.	DATE	DESCRIPTION
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PROJECT NAME:

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6246 190th St. E.
Prior Lake, MN 55372

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SIGNATURE:

ROBERT C CHILSON
NAME

40856 LICENSE #

07/24/19 DATE

PROJECT NUMBER: 19.483.0

DATE OF ISSUE: 07/24/19

DRAWN BY: DJL

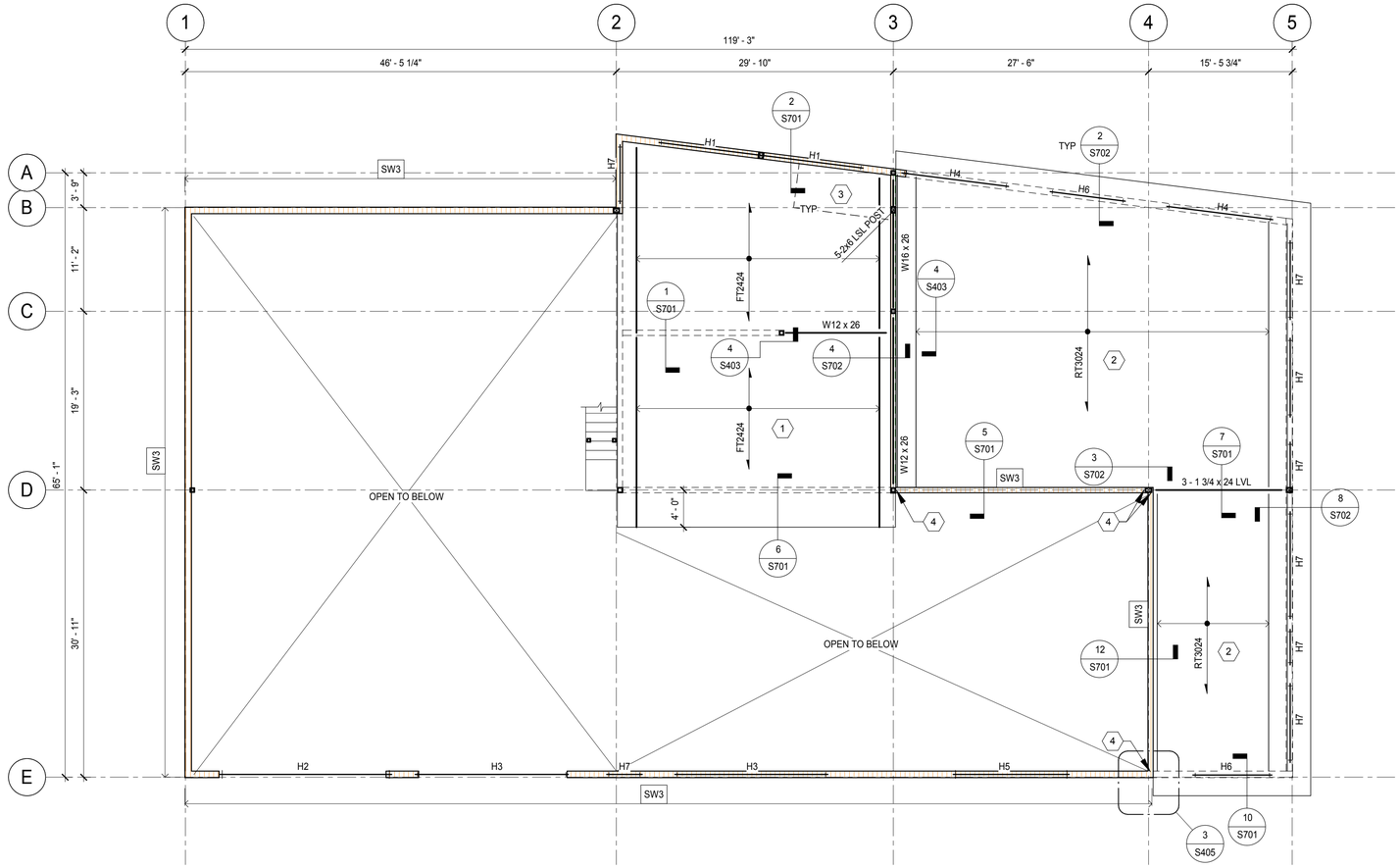
CHECKED BY: ED

SHEET NAME:

FOUNDATION PLAN

SHEET NO:

S201



1 MEZZANINE FRAMING PLAN

1/8" = 1'-0"

REFERENCE NOTES:

1. SEE SHEET S001 FOR SHEET INDEX, TYPICAL ABBREVIATIONS AND LEGENDS.
2. SEE SHEET S002 FOR GENERAL STRUCTURAL NOTES.
3. SEE SHEET S301 FOR BUILDING ELEVATIONS.
4. SEE SHEET S401 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
5. SEE SHEET S402 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
6. SEE SHEET S403 FOR WOOD SCHEDULES AND TYPICAL DETAILS.
7. SEE SHEET S500 SERIES FOR FOUNDATION AND CONCRETE FRAMING DETAILS.
8. SEE SHEET S700 SERIES FOR FRAMING DETAILS.

PLAN NOTES (UNLESS NOTED OTHERWISE):

1. TOP OF SUBFLOOR ELEVATION (TSE) = 112' - 8". REFER TO ARCHITECTURAL DRAWINGS FOR FINISHED FLOOR ELEVATION.
2. TYPICAL FLOOR FRAMING IS 24" DEEP PRE-ENGINEERED WOOD FLOOR TRUSSES. TRUS SPACING SHALL BE DETERMINED BY THE TRUSS PROVIDER BASED ON LOADING REQUIREMENTS.
3. VERIFY SIZE, LOCATION AND NUMBER OF ALL OPENINGS THROUGH FLOOR WITH ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS.
4. HATCHED WALLS ON PLAN INDICATE BEARING WALLS.
5. ALL RAILINGS AT BALCONIES AND DECKS SHALL RETURN TO BUILDING WALLS AND BE ANCHORED TO BLOCKING IN THE WALLS.
6. SEE WOOD UNIT WALL FRAMING SCHEDULE FOR WOOD WALL TYPES AND HEADER REQUIREMENTS.
7. BEAMS AND HEADERS SHALL BE DROPPED BELOW JOIST/TRUSS BEARING ELEVATION.
8. AT HEATING/COOLING UNITS ADJACENT TO LOAD BEARING INTERIOR WALLS, PROVIDE H__ OVER MECHANICAL DUCT OPENINGS WITH TRIMMERS AS SHOWN IN SCHEDULE.
9. AT INTERIOR NON-BEARING WALLS PROVIDE 1-TRIMMER STUD AT EACH SIDE OF WALL OPENINGS TO MATCH WALL STUDS AND PROVIDE HEADERS AS FOLLOWS:
   OPENINGS UP TO 6'-0" — 2 - 2x8 HEADER
   OPENINGS UP TO 10'-0" — 3 - 2x8 OR 2 - 2x10 HEADER

KEYNOTES:

1. 2 - LAYERS 23/32 APA RATED SHEATHING W/ 48/24 SPAN RATING. SEE DETAIL 6/ S404 FOR NAILING.
2. 19/32 APA RATED SHEATHING W/ 40/20 SPAN RATING. SEE DETAIL 6/ S404 FOR NAILING.
3. TRUSS SUPPLIER SHALL DESIGN FLOOR TRUSSES FOR 1,000 LBS CONCENTRATED LOAD PLACED AT ANY LOCATION IN THIS AREA.
4. SIMPSON CMSTC16 STRAP, LAP 2'-0" ONTO STUD WALL ABOVE AND BELOW LOW ROOF. NAIL TO STUD WALL WITH 29 - 16d SINKER NAILS AT EACH END OF STRAP. PROVIDE 3 - 2x6 POST IN WALL AT EACH STRAP LOCATION.

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SIGNATURE:

ROBERT C CHILSON
NAME

40856 — LICENSE #
07/24/19 — DATE

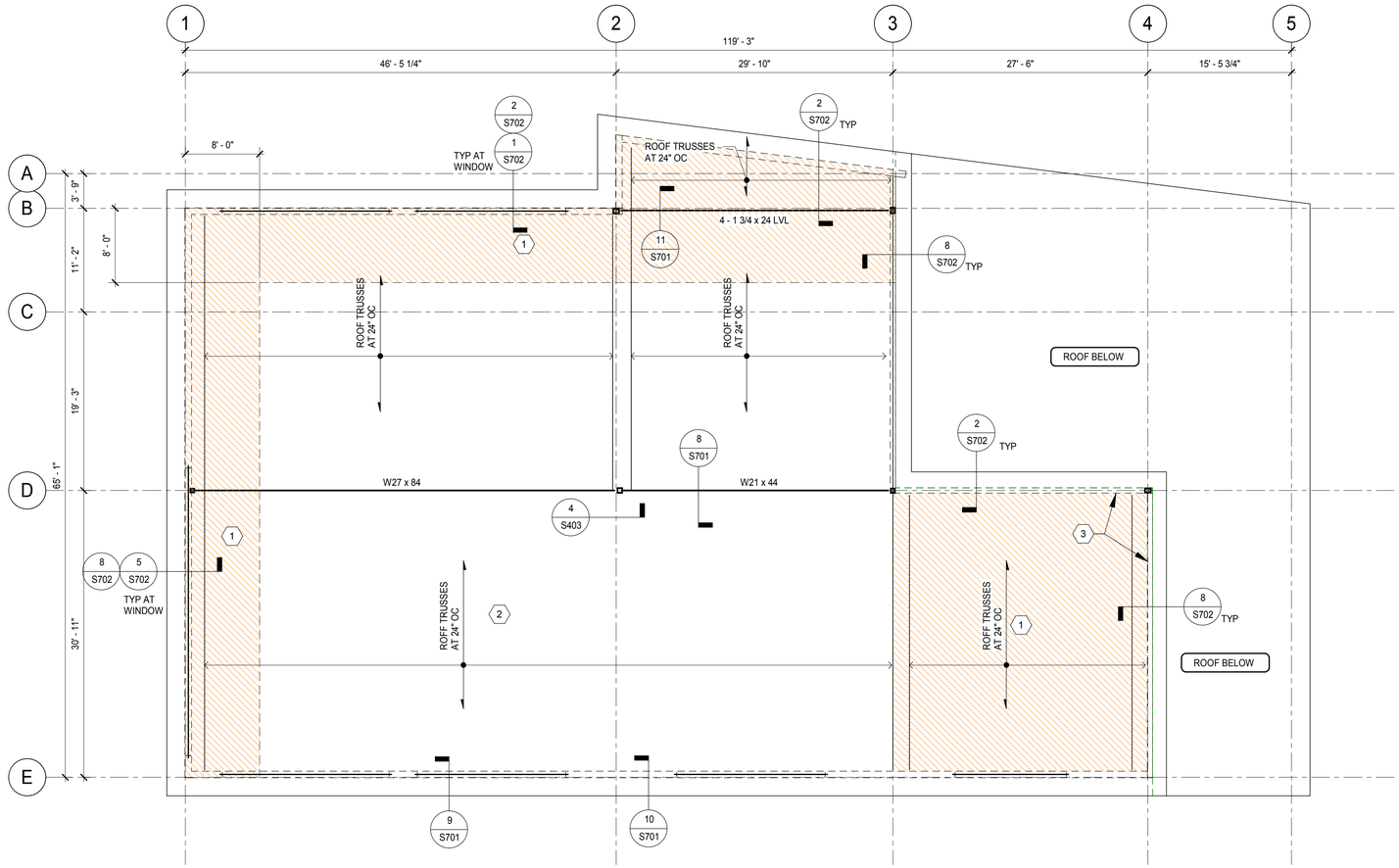
PROJECT NUMBER: 19.483.0
DATE OF ISSUE: 07/24/19
DRAWN BY: DJL
CHECKED BY: ED

SHEET NAME:

MEZZANINE FRAMING PLAN

SHEET NO:

S202



1 ROOF FRAMING PLAN

1/8" = 1'-0"

REFERENCE NOTES:

1. SEE SHEET S001 FOR SHEET INDEX, TYPICAL ABBREVIATIONS AND LEGENDS.
2. SEE SHEET S002 FOR GENERAL STRUCTURAL NOTES.
3. SEE SHEET S301 FOR BUILDING ELEVATIONS.
4. SEE SHEET S401 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
5. SEE SHEET S402 FOR FOUNDATION SCHEDULES AND TYPICAL DETAILS.
6. SEE SHEET S403 FOR WOOD SCHEDULES AND TYPICAL DETAILS.
7. SEE SHEET S500 SERIES FOR FOUNDATION AND CONCRETE FRAMING DETAILS.
8. SEE SHEET S700 SERIES FOR FRAMING DETAILS.

PLAN NOTES (UNLESS NOTED OTHERWISE):

1. TOP OF SHEATHING ELEVATION (TSE) = VARIES. REFER TO ARCHITECTURAL DRAWINGS FOR FINISHED FLOOR ELEVATION.
2. TYPICAL ROOF FRAMING IS CONSTRUCTED WITH PRE-ENGINEERED WOOD ROOF TRUSSES. ROOF TRUSS DEPTH VARIES, SEE DETAILS ON SHEET S701 AND S702 TRUSS SPACING SHALL BE DETERMINED BY THE TRUSS PROVIDER BASED ON LOADING REQUIREMENTS.
3. VERIFY SIZE, LOCATION AND NUMBER OF ALL OPENINGS THROUGH FLOOR WITH ARCHITECTURAL, MECHANICAL AND ELECTRICAL DRAWINGS.
4. DASHED WALLS ON PLAN INDICATE BEARING WALLS.
5. SEE WOOD UNIT WALL FRAMING SCHEDULE FOR WOOD WALL TYPES AND HEADER REQUIREMENTS.
6. BEAMS AND HEADERS SHALL BE DROPPED BELOW JOIST/TRUSS BEARING ELEVATION.
7. AT INTERIOR NON-BEARING WALLS PROVIDE 1-TRIMMER STUD AT EACH SIDE OF WALL OPENINGS TO MATCH WALL STUDS AND PROVIDE HEADERS AS FOLLOWS:
   OPENINGS UP TO 6'-0" 2 - 2x8 HEADER
   OPENINGS UP TO 10'-0" 3 - 2x8 OR 2 - 2x10 HEADER

KEYNOTES:

1. 19/32 APA RATED SHEATHING BLOCK WOOD DIAPHGRAM W/ 3" NOMINAL WIDTH BLOCKING AT ALL PANEL EDGES. ATTACH SHEATHING WITH 10d NAILS AT 4" OC AT DIAPHGRAM BOUNDARIES AND 6" OC AT OTHER PANEL EDGES.
2. 19/32 APA RATED SHEATHING W/ 40/20 SPAN RATING. SEE DETAIL 6/ S404 FOR NAILING.
3. USE #14-13 FASTENER AT 4" OC AT PANEL EDGES, 1" MIN FASTENER PENETRATION DEPTH AS PER SUPPLIER RECOMMENDATIONS.

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SIGNATURE:

ROBERT C CHILSON
NAME

40856 LICENSE #

07/24/19 DATE

PROJECT NUMBER: 19.483.0

DATE OF ISSUE: 07/24/19

DRAWN BY: DJL

CHECKED BY ED

SHEET NAME:

ROOF FRAMING PLAN

SHEET NO:

S203

EPOXY-COATED REINFORCING BAR LAP SPLICE SCHEDULE								
BAR SIZE	f'c = 3,000 PSI		f'c = 4,000 PSI		f'c = 5,000 PSI		f'c ≥ 6,000 PSI	
	CLASS A	CLASS B	CLASS A	CLASS B	CLASS A	CLASS B	CLASS A	CLASS B
#3	26"	32"	22"	28"	20"	26"	18"	24"
#4	34"	44"	30"	38"	26"	34"	24"	32"
#5	42"	54"	36"	48"	32"	42"	30"	38"
#6	50"	64"	44"	56"	40"	50"	36"	46"
#7	72"	94"	64"	82"	56"	74"	52"	66"
#8	84"	108"	72"	94"	64"	84"	60"	76"
#9	94"	122"	82"	106"	72"	94"	66"	86"
#10	106"	136"	92"	118"	82"	106"	74"	96"
#11	116"	151"	102"	132"	90"	118"	82"	108"

NOTES:
1. EPOXY-COATED REINFORCING BAR LAP SPLICE SCHEDULE APPLIES TO EPOXY-COATED, GRADE 60 REINFORCING BARS IN NORMAL WEIGHT CONCRETE.
2. PROVIDE CLASS A LAP UNLESS NOTED OTHERWISE.
3. FOR UNCOATED BAR, MULTIPLY THE ABOVE LENGTHS BY 0.7.
4. FOR LIGHTWEIGHT CONCRETE, MULTIPLY THE ABOVE LENGTHS BY 1.3.
5. FOR TOP BARS IN BEAMS AND HORIZONTAL WALL REINFORCING, MULTIPLY THE ABOVE LENGTHS BY 1.3.
6. MAXIMUM SPACING OF BARS BEING SPLICED IS ONE FIFTH THE LAP SPLICE LENGTH, NOT TO EXCEED 6".

CONCRETE PAD FOOTING SCHEDULE					
				REINFORCING BOTTOM BARS	
MARK	LENGTH	WIDTH	THICKNESS	LONG	TRANS
F1	3' - 0"	3' - 0"	1' - 0"	3-#5	3-#5
F2	3' - 6"	3' - 6"	1' - 0"	4-#5	4-#5
F3	4' - 0"	4' - 0"	1' - 0"	4-#5	4-#5
F4	5' - 0"	5' - 0"	1' - 0"	5-#5	5-#5

WALL FOOTING SCHEDULE				
			REINFORCING	
MARK	WIDTH	THICKNESS	LONG	COMMENTS
WF1	2' - 0"	1' - 0"	3 - #5	
WF2	4' - 0"	1' - 6"	4 - #5	

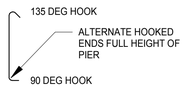
NOTES:
1. SEE TYPICAL WALL FOOTING DETAILS FOR ADDITIONAL INFORMATION.
2. LONGITUDINAL (LONG) REINFORCING IS CONTINUOUS. PROVIDE CLASS "A" LAP SPLICE TYP UNLESS NOTED OTHERWISE.
3. PROVIDE CORNER BARS AT CORNERS AND INTERSECTIONS.

CONCRETE PIER SCHEDULE				
		REINFORCING		
MARK	SIZE	VERT BARS	TIES	COMMENTS
P1	16 x 16	4 - #8	#3 AT 12"	

NOTES:
1. SEE TYPICAL COLUMN, PIER AND FOOTING DETAIL FOR ADDITIONAL INFORMATION.
2. SEE TYPICAL CONCRETE PIER BAR AND TIE LAYOUT FOR REINFORCING CONFIGURATIONS.
3. PROVIDE STANDARD 90 DEGREE HOOK AT VERTICAL (VERT) BARS TO FOOTING.
4. CONTRACTORS OPTION PROVIDE HOOKED DOWELS LAP SPLICED TO VERTICAL REINFORCING. MATCH SIZE AND LOCATION OF VERTICAL REINFORCING.

1 S401 EPOXY-COATED REINFORCING BAR LAP SPLICE SCHEDULE
NO SCALE

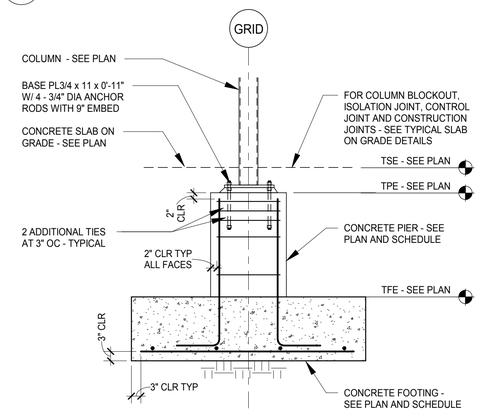
4 BAR SQUARE



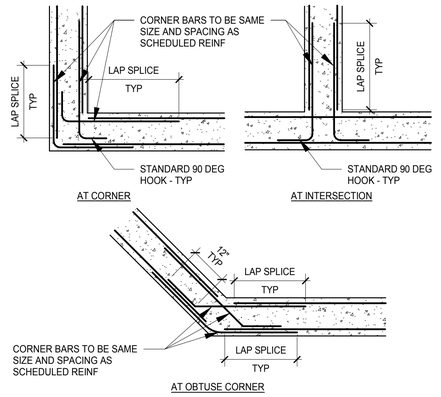
CROSS TIE SCHEMATIC

NOTES:
1. IF CLEAR SPACING BETWEEN VERTICAL BARS IS GREATER THAN 6", PROVIDE ADDITIONAL CROSS TIES, SHOWN DASHED.

2 S401 CONCRETE FOOTING SCHEDULE
NO SCALE

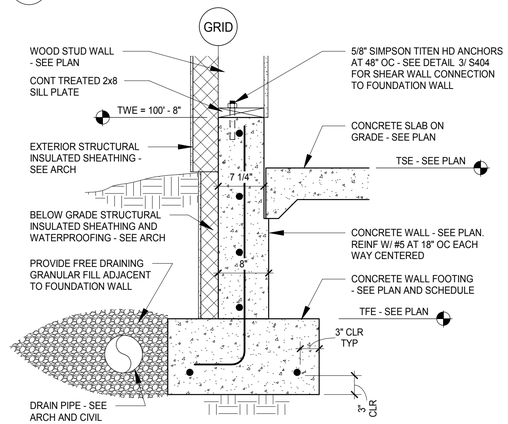


3 S401 WALL FOOTING SCHEDULE
NO SCALE



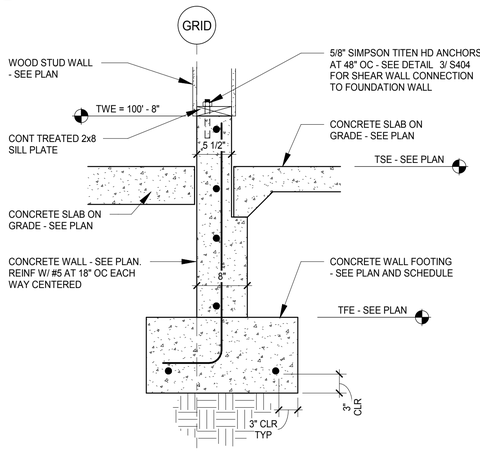
NOTES:
1. VERTICAL REINFORCING NOT SHOWN FOR CLARITY.

4 S401 CONCRETE PIER SCHEDULE
NO SCALE

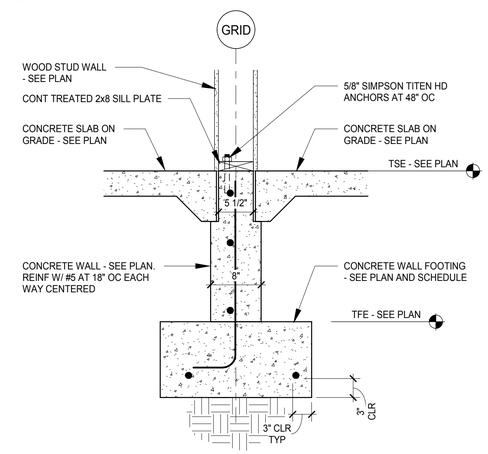


NOTES:
1. STRUCTURAL SLAB AT TOP OF WALL MUST BE IN PLACE WITH POSITIVE CONNECTION TO TOP OF WALL AND CURED A MINIMUM OF 72 HOURS BEFORE BACKFILL IS PLACED ABOVE LEVEL OF CONCRETE SLAB ON GRADE.

5 S401 CONCRETE PIER BAR AND TIE LAYOUT
NO SCALE



6 S401 TYPICAL HSS/PIPE COLUMN, CONCRETE PIER AND FOOTING DETAIL
NO SCALE



7 S401 TYPICAL CORNER BAR PLACING DETAIL
NO SCALE

8 S401 TYPICAL CONCRETE WALL AND FOOTING DETAIL
NO SCALE

9 S401 TYPICAL CONCRETE WALL AND FOOTING DETAIL
NO SCALE

10 S401 TYPICAL CONCRETE WALL AND FOOTING DETAIL
NO SCALE

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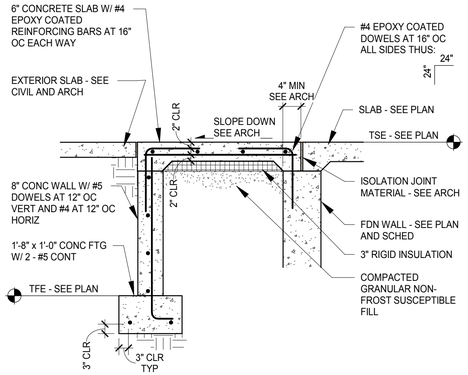
SIGNATURE:
ROBERT C CHILSON
NAME
40856 LICENSE #
07/24/19 DATE

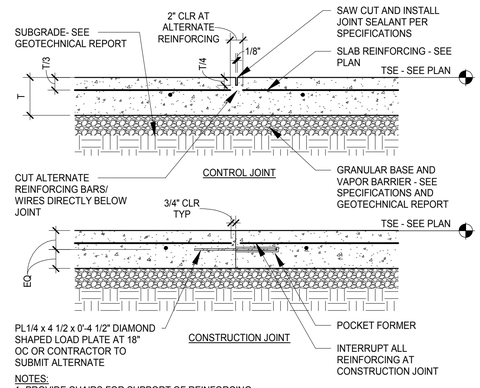
PROJECT NUMBER: 19.483.0
DATE OF ISSUE: 07/24/19
DRAWN BY: DJL
CHECKED BY: ED

SHEET NAME:
TYPICAL SCHEDULES AND DETAILS

SHEET NO:
S401

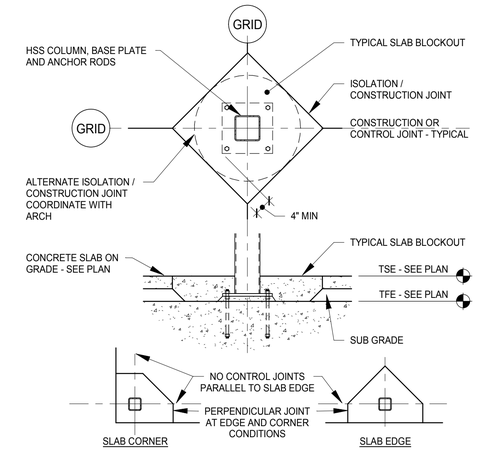


1 S402 TYPICAL CONCRETE STOOP DETAIL
NO SCALE

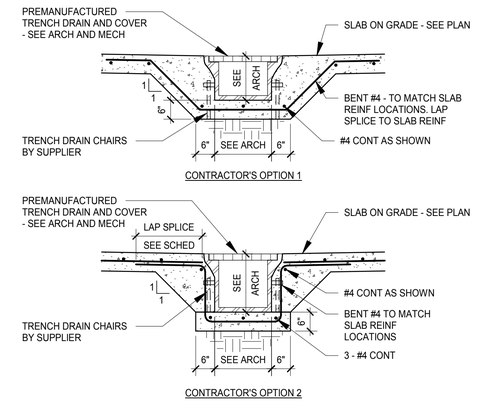


NOTES:
1. PROVIDE CHAIRS FOR SUPPORT OF REINFORCING.
2. AT EXTERIOR SLAB ON GRADE LOCATIONS, VAPOR BARRIER IS NOT REQUIRED.
3. PROVIDE DIAMOND SHAPED LOAD PLATE COMPLIANT WITH ACI 302.1 R.

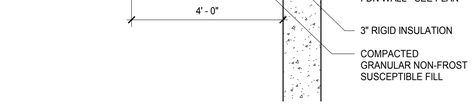
2 S402 TYPICAL SLAB ON GRADE CONSTRUCTION
NO SCALE



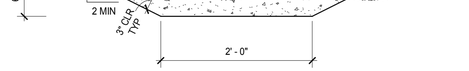
3 S402 TYPICAL COLUMN ISOLATION JOINT
NO SCALE



4 S402 TYPICAL SECTION AT TRENCH DRAIN
NO SCALE



5 S402 TYPICAL CONCRETE APRON SLAB DETAIL
NO SCALE



NOTES:
1. THICKENED SLAB SHALL BE CENTERED ON STAIR BEARING LOCATION. SEE ARCH FOR STAIR LOCATIONS.
2. EXTENT OF THICKENED SLAB TO BE 2'-0" WIDER THAN STAIR WIDTH.

6 S402 TYPICAL THICKENED SLAB ON GRADE AT STAIR DETAIL
NO SCALE

ThreeRivers PARK DISTRICT
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CONSULTANT:
OERTEL ARCHITECTS, LTD.
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SEE STRUCTURE.

REVISION / ISSUE:

NO.	DATE	DESCRIPTION
	07/24/19	CONSTRUCTION DOCUMENTS

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTAINANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE:
ROBERT C CHILSON
NAME
40856 LICENSE #
07/24/19 DATE

PROJECT NUMBER: 19.483.0
DATE OF ISSUE: 07/24/19
DRAWN BY: DJL
CHECKED BY: ED

SHEET NAME:
TYPICAL SCHEDULES AND DETAILS

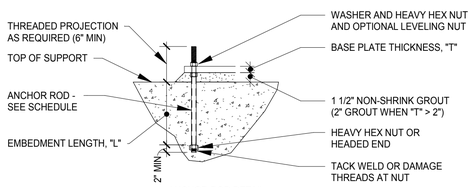
SHEET NO:
S402

COLUMN BASE PLATE AND ANCHOR ROD SCHEDULE								
BASE PLATE MARK	BASE PLATE				ANCHOR RODS			COMMENTS
	"N" (IN)	"B" (IN)	"T" (IN)	"X" (IN)	NO.	DIA (IN)	EMBED "L" (IN)	
BP1	11	11	3/4	1 1/2	4	3/4	9	
BP2	12	12	3/4	1 1/2	4	3/4	9	

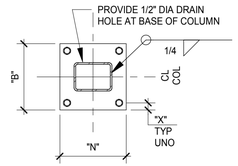
NOTES:
1. ANCHOR RODS SHALL BE ASTM F1554, GRADE 36.
2. BASE PLATES SHALL BE ASTM A36.
3. MILL COLUMN BASE AND/OR BASE PLATE AS NECESSARY FOR FULL CONTACT.
4. BASE PLATE THICKNESS INDICATED IS MINIMUM THICKNESS AFTER MILLING.
5. ANCHOR RODS SHALL NOT BE SET INTO CONCRETE AFTER CONCRETE IS CAST.
6. PROVIDE MAXIMUM HOLE SIZE IN BASE PLATE FOR ANCHOR RODS PER AISC TABLE 14-2, UNLESS NOTED OTHERWISE.
7. SEE TYPICAL COLUMN BASE PLATE DETAILS FOR ADDITIONAL INFORMATION.

1 S403 TYPICAL COLUMN BASE PLATE AND ANCHOR ROD SCHEDULE

NO SCALE



ANCHOR ROD DETAIL



PLAN AT HSS/PIPE COLUMN

NOTES:
1. SEE SCHEDULE FOR BASE PLATE AND ANCHOR ROD DIMENSIONS.
2. DIMENSION "N" IS PARALLEL TO WF WEB OR LONGER HSS DIMENSION.

2 S403 TYPICAL COLUMN BASE PLATE DETAILS

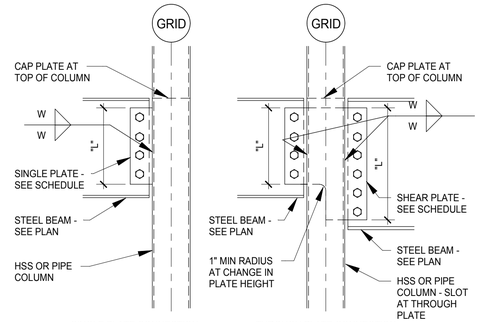
NO SCALE

SINGLE PLATE CONNECTION SCHEDULE					
BEAM SIZE	ROWS OF BOLTS	SINGLE PLATE		WELD (IN)	COMMENTS
	"N"	LENGTH (IN) "L"	THICKNESS (IN)	"W"	
W8 ,W10	2	6	3/8	1/4	
W12, W14	3	9	3/8	1/4	
W16	4	12	3/8	1/4	
W18	5	15	3/8	1/4	
W21	6	18	3/8	1/4	
W24	7	21	3/8	1/4	

NOTES:
1. SEE TYPICAL SINGLE PLATE CONNECTION DETAILS FOR ADDITIONAL INFORMATION.
2. WELD SIZE SHOWN IS THE FILLET WELD LEG DIMENSION FOR PERPENDICULAR JOINTS. AT SKEWED CONNECTION CONDITIONS, SEE THE SKEWED CONNECTION DETAIL FOR WELD REQUIREMENTS.

3 S403 TYPICAL SINGLE PLATE CONNECTION SCHEDULE

NO SCALE



SINGLE PLATE CONNECTION THROUGH PLATE CONNECTION

NOTES:
1. PROVIDE THROUGH PLATE CONNECTIONS AT HSS OR PIPE COLUMNS WITH WALL THICKNESSES LESS THAN 1/4" AND WHERE INDICATED ON PLAN AND/OR SCHEDULE.
2. PROVIDE 1/2" CAP PLATE WITH SEAL WELDS AT TOP OF COLUMN WHERE NO COLUMN IS PRESENT ABOVE THE CONNECTION. WHERE CAP PLATES ARE INDICATED IN A COLUMN SCHEDULE PROVIDE THE SCHEDULED PLATE.
3. AT THROUGH PLATES WHERE THE SCHEDULED SINGLE PLATE THICKNESS DIFFERS FOR BEAMS ON EITHER SIDE OF THE COLUMN, PROVIDE A THROUGH PLATE WITH THE LARGER OF THE TWO SCHEDULED PLATE THICKNESSES.
4. SEE TYPICAL SINGLE PLATE CONNECTION SCHEDULE AND DETAILS FOR ADDITIONAL INFORMATION.

4 S403 TYPICAL SINGLE PLATE CONNECTIONS AT HSS AND PIPE COLUMN DETAILS

NO SCALE

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STEEL SCHEDULES AND DETAILS

SHEET NO:

S403

WOOD SHEAR WALL CONSTRUCTION SCHEDULE

WALL TYPE	WALL PANEL CONSTRUCTION	WALL PANEL FASTENING				TOP AND SILL PLATE FASTENING - SEE NOTE 20	
		EDGE SPACING	INTERMEDIATE SUPPORT SPACING	MINIMUM FASTENER SIZE	SEE NOTE	SIMPSON OR USP CLIP ANGLE	COMMON OR FRAMING NAILS
SW1	1 LAYER 5/8" GYP BOARD BOTH SIDES OF WALL - BLOCKED	4"	4"	6d COOLER OR WALLBOARD NAIL 1 3/4" LONG OR 16 GA. STAPLE, 1 1/2" LEGS, 1 5/8" LONG	11 TO 15	A35 OR MP34 AT 18" OC	16d AT 6" OR 3" x 0.131" AT 4"
SW2	2 LAYERS 5/8" GYP BOARD BOTH SIDES OF WALL - BLOCKED	9" BASE PLY 7" FACE PLY	9" BASE PLY 7" FACE PLY	BASE PLY - 6d COOLER NAIL OR 1 3/4" LONG WALLBOARD NAIL OR 16 GA. STAPLE, 1 1/2" LEGS, 1 5/8" LONG FACE PLY - 8d COOLER NAIL OR 2 3/8" LONG WALLBOARD NAIL OR 15 GA. STAPLE, 1 1/2" LEGS, 2 1/4" LONG	11 TO 15	A35 OR MPA1 AT 12" OC	16d AT 4" OR 3" x 0.131 AT 3"
SW3	STRUCTURAL INSULATED SHEATHING - BLOCKED	4"	12"	USE #14 - 13	17, 22		

NOTES:
1. PROVIDE 2 STUDS AT EACH END OF SHEAR WALL. END STUDS SHALL RECEIVE EDGE NAILING.
2. ALL BLOCKING IN WALLS SHALL MEET OR EXCEED STUD GRADE.
3. PANEL JOINTS SHALL OCCUR AT THE CENTERLINE OF STUDS AND BLOCKING.
4. VERIFY WITH ARCHITECT IF ADDITIONAL LAYERS OF GYP BOARD ARE REQUIRED FOR FINISHES.
5. CONTRACTOR'S OPTION - PROVIDE CLIPS AT TOP AND SILL PLATE BY ALTERNATE MANUFACTURER THAT MEET OR EXCEED CAPACITY OF CLIPS INDICATED IN SCHEDULE.
6. SEE SHEAR WALL BASE CONNECTION SCHEDULE FOR ANCHORAGE TO SUPPORT MATERIAL.
7. SEE HOLD DOWN SCHEDULE FOR HOLD DOWN INFORMATION.
8. PROVIDE NAILING AT CLIP ANGLES PER MANUFACTURER'S RECOMMENDATIONS.
9. TOP AND SILL PLATE NAILING SHALL BE STAGGERED WHERE NAILS ARE SPACED AT 2" OC.
10. ALL FASTENERS IN CONTACT WITH TREATED WOOS SHALL BE GALVANIZED.

ADDITIONAL NOTES PER SCHEDULE:
11. ALL WALLBOARD NAILS INDICATED IN SCHEDULE SHALL BE 0.120" DIA AND HAVE MINIMUM 3/8" HEAD.
12. STAPLES SHALL BE GALVANIZED, HAVE 7/16" MINIMUM CROWN WIDTH AND BE INSTALLED PARALLEL TO FRAMING MEMBERS.
13. 6d NAILS MAY BE SUBSTITUTED WITH NO. 6 1 7/8" TYPE S OR W DRYWALL SCREWS.
14. PROVIDE EXTERIOR GYP BOARD WHERE SHEAR WALL IS AN EXTERIOR WALL.
15. BLOCK ALL PANEL EDGES WITH WOOD BLOCKING TO MATCH THE WALL STUD SIZE.
16. BLOCK ALL PANEL EDGES WITH WOOD BLOCKING 2" NOMINAL OR WIDER.
17. BLOCK ALL PANEL EDGES WITH WOOD BLOCKING 3" NOMINAL OR WIDER. STAGGER NAILS.
18. PROVIDE 1 1/2" MINIMUM PENETRATION INTO STUD AT 10d NAIL AND 1 3/8" MIN AT 8d NAIL.
19. STUDS AT ADJOINING PANEL EDGES SHALL BE 3" NOMINAL WIDTH OR GREATER.
20. USE EITHER SPECIFIED CLIP ANGLE OR NAILING AS SPECIFIED BY REFERRING DETAIL.
21. SEE S203 FOR EXTERIOR STRUCTURAL INSULATED SHEATHING FASTENING.
22. STRUCTURAL INSULATED SHEATHING SHALL BE ABLE TO PROVIDE AN ALLOWABLE SHEAR WALL CAPACITY OF A MINIMUM 350 PLF.

WOOD HEADER AND TRIMMER STUD SCHEDULE

MARK	MAX ROUGH OPENING WIDTH	HEADER	TRIMMER STUDS LEVEL 1	COMMENTS
H1	--	4 - 1.75 x 24 LVL	3T, 2K	2 - 1.75 x 5.5 LVL WINDOW SILL
H2	--	3 - 1.75 x 14 LVL	2T, 6K	HEADER W/ 1 - 1.75 x 7.25 LVL TOP AND BOTTOM
H3	--	2 - 1.75 x 16 LVL	2T, 6K	HEADER W/ 1 - 1.75 x 7.25 LVL TOP AND BOTTOM
H4	--	2 - 1.75 x 14 LVL	2T, 1K	HEADER W/ 1 - 1.75 x 5.5 LVL TOP AND BOTTOM 2 - 1.75 x 5.5 LVL WINDOW SILL
H5	--	2 - 1.75 x 11.25 LVL	2T, 6K	HEADER W/ 1 - 1.75 x 7.25 LVL TOP AND BOTTOM
H6	--	2 - 1.75 x 9.5 LVL	2T, 1K	
H7	--	1 - 1.75 x 5.5 LVL	1T, 1K	

NOTES:
1. SEE ARCHITECTURAL DRAWINGS FOR EXACT SIZE AND LOCATION OF WALL OPENINGS.
2. HEADERS SPECIFICALLY INDICATED ON PLAN SUPERCEDE THOSE SHOWN IN THIS SCHEDULE.
3. SEE TYPICAL WOOD WALL FRAMING ELEVATION FOR ADDITIONAL INFORMATION.
4. "XT" INDICATES THE NUMBER OF TRIMMER STUDS. "XK" INDICATES THE NUMBER OF KING POSTS.
5. TRIMMER STUDS AND KING POSTS ARE DESIGNED USING LAMINATED STRAND LUMBER (LSL).

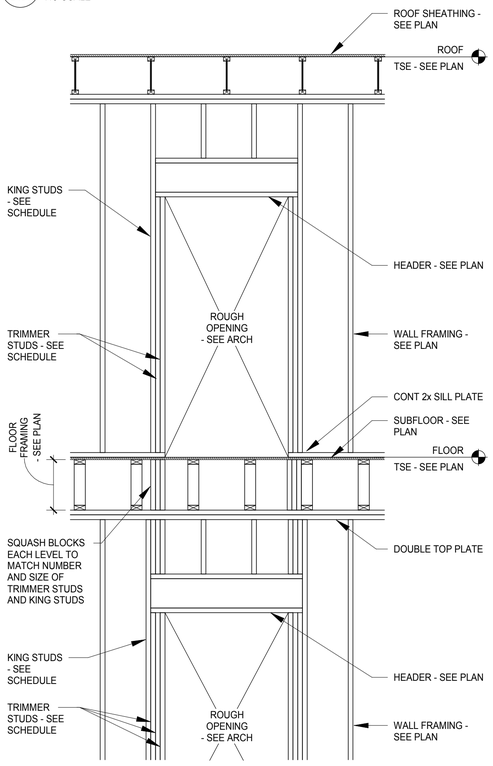
WOOD SHEAR WALL BASE CONNECTION SCHEDULE

	MINIMUM EMBEDMENT					COMMENTS
	0.145" DIA	1/4" DIA	1/2" DIA	5/8" DIA	3/4" DIA	
CONC SCREW ANCHOR	---	---	---	3 1/4"	---	
SHEAR WALL TYPE	MAXIMUM FASTENER SPACING					
SW1	---	---	---	48"	---	
SW2	---	---	---	24"	---	
SW3	---	---	---	48"	---	

NOTES:
1. CONTRACTOR SHALL SELECT PREFERRED BASE FASTENER(S) FROM THIS SCHEDULE AND INSTALL PER MANUFACTURER'S SPECIFICATIONS.
2. SEE WOOD SHEAR WALL CONSTRUCTION SCHEDULE FOR ADDITIONAL INFORMATION.

1 S404 WOOD SHEAR WALL CONSTRUCTION SCHEDULE

NO SCALE



NOTES:
1. EACH END OF HEADER SHALL FULLY BEAR ON TRIMMER STUDS.
2. ALL KING AND TRIMMER STUDS SHALL BE CONTINUOUS TO THE BASE OF LOWEST WOOD LEVEL. PROVIDE SQUASH BLOCKS AS NEEDED WITHIN THE TRUSS DEPTH.

4 S404 TYPICAL WOOD WALL FRAMING ELEVATION

NO SCALE

WOOD FASTENING SCHEDULE

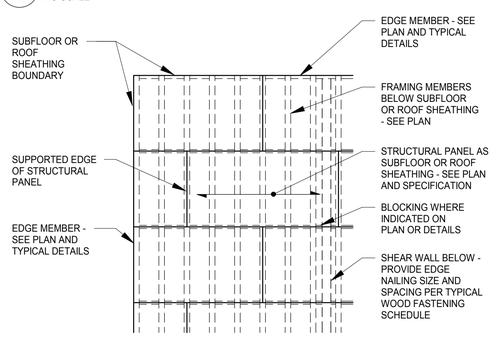
CONNECTED ELEMENTS	FASTENING LOCATION	FASTENING SIZE AND PATTERN
1. JOIST OR TRUSS TO SILL, GIRDER OR WALL TOP PLATE	TOENAIL	3 - 8d COMMON OR 3 - 3" x 0.131" NAIL
2. BRIDGING TO JOIST OR TRUSS	TOENAIL EACH END	2 - 8d COMMON OR 2 - 3" x 0.131" NAILS
3. SILL PLATE TO JOIST, TRUSS OR BLOCKING	FACE NAIL	3 - 16d AT 16" OC OR 3 - 3" x 0.131" NAILS AT 16" OC
4. TOP PLATE TO STUD	END NAIL	2 - 16d COMMON OR 3 - 3" x 0.131" NAIL
5. STUD TO SILL PLATE	TOENAIL	4 - 8d COMMON OR 4 - 3" x 0.131" NAIL
6. STUD TO SILL PLATE	END NAIL	2 - 16d COMMON OR 3 - 3" x 0.131" NAIL
7. DOUBLE STUDS	FACE NAIL	16d COMMON AT 24" OC OR 3" x 0.131" NAIL AT 8" OC
8. DOUBLE TOP PLATES	FACE NAIL	16d COMMON AT 16" OC OR 3" x 0.131" NAIL AT 12" OC
9. DOUBLE TOP PLATES	LAP SPLICE	16 - 3" x 0.131" NAILS
10. BLOCKING BETWEEN JOISTS, TRUSSES OR RAFTERS TO TOP PLATE	TOE NAIL	3 - 8d COMMON OR 3 - 3" x 0.131" NAIL
11. RIM JOIST TO TOP PLATE	TOENAIL	8d COMMON AT 6" OC OR 3" x 0.131" NAILS AT 6" OC
12. TOP PLATE INTERSECTIONS	FACE NAIL	2 - 16d COMMON OR 3 - 3" x 0.131" NAIL
13. CONTINUOUS HEADER, TWO PIECES	FACE NAIL	ROWS 16d COMMON AT 16" OC - ONE ROW EACH EDGE
14. CEILING JOISTS OR TRUSSES TO PLATE	TOENAIL	3 - 8d COMMON OR 5 - 3" x 0.131" NAIL
15. CONTINUOUS HEADER TO STUD	TOENAIL	4 - 8d COMMON
16. CEILING JOISTS OR TRUSSES LAPPED OVER PARTITIONS	FACE NAIL	3 - 16d COMMON OR 4 - 3" x 0.131" NAIL
17. CEILING JOISTS OR TRUSSES TO PARALLEL RAFTERS	FACE NAIL	3 - 16d COMMON OR 4 - 3" x 0.131" NAIL
18. RAFTER TO PLATE	TOENAIL	3 - 8d COMMON OR 3 - 3" x 0.131" NAIL
19. BUILT-UP CORNER STUDS	FACE NAIL	16d COMMON AT 24" OC 3 " x 0.131" NAIL AT 16" OC
20. BUILT-UP GIRDER AND BEAMS, 3 OR MORE PIECES	FACE NAIL AT TOP AND BOTTOM STAGGERED AT OPPOSITE SIDES	20d COMMON AT 32" OC OR 3 " x 0.131" NAIL AT 24" OC
21. WOOD STRUCTURAL PANELS AND PARTICLE BOARD AS SUBFLOOR, ROOF AND WALL SHEATHING APPLICATIONS TO WALL FRAMING	6" OC AT EDGES AND AT SHEARWALLS, 12" AT INTERMEDIATE SUPPORTS EXCEPT 6" AT SUPPORTS WHERE SPANS ARE 48" OR MORE	1/2" THICKNESS OR LESS - 6d COMMON 19/32" TO 3/4" THICKNESS - 10d COMMON 7/8" TO 1" THICKNESS - 10d COMMON NOTE: 8d COMMON IS THE MINIMUM REQUIRED FOR WOOD STRUCTURAL PANELS IN ROOF SHEATHING APPLICATIONS

6 S404 TYPICAL WOOD FASTENING SCHEDULE

NO SCALE

2 S404 TYPICAL WOOD HEADER AND TRIMMER STUD SCHEDULE

NO SCALE



NOTES:
1. FLOOR AND ROOF SHEATHING SHALL BE PLACED IN STAGGERED LAY-UP PATTERN ORIENTED AS SHOWN.
2. PROVIDE NAILING AT EDGES AND INTERMEDIATE SUPPORTS OF SUBFLOOR AND SHEATHING PANELS AS INDICATED IN THE TYPICAL WOOD FASTENING SCHEDULE.

5 S404 TYPICAL WOOD SUBFLOOR AND ROOF SHEATHING PLAN

NO SCALE

3 S404 WOOD SHEAR WALL BASE CONNECTION SCHEDULE

NO SCALE

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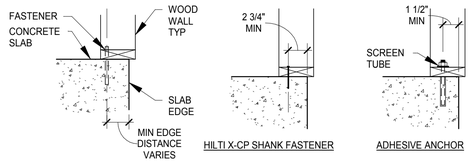
WOOD WALL SCHEDULES AND DETAILS
SHEET NO:
S404

HOLD DOWN SCHEDULE						
	WALL END CONSTR		HOLD DOWN ANCHOR			HOLD
HOLD DOWN MARK	NO. END STUDS	BUILT-UP STUD FASTENERS	SIMPSON OR USP	ANCHOR DIA	FASTENERS TO WALL END STUD	DOWN FORCE (KIPS)
HD1	3 - 2x	-	HDU11-SDS2.5			8.0
HD2	3 - 2x	-	HDU8-SDS2.5			6.6
HD3	2 - 2x	-	HDU8-SDS2.5			5.8
HD4	2 - 2x	-	DT2Z			2.1

NOTES:
1. INSTALL BUILT-UP FASTENERS ON FACE OF STUD OPPOSITE THE HOLD DOWN, FULL HEIGHT OF THE STUD. BUILT-UP FASTENERS ARE ADDITIONAL TO THE TYPICAL WOOD FASTENING SCHEDULE REQUIREMENTS.
2. FORCES INDICATED IN SCHEDULE ARE SERVICE TENSION OR COMPRESSION FORCES.
3. PRECAST COMPONENTS SHALL BE DESIGNED BY THE SUPPLIER FOR THE LOADS SHOWN IN SCHEDULE.
4. 2x END STUDS SHALL MATCH THE TYPICAL WALL STUD DEPTH, UNLESS NOTED OTHERWISE.
5. AT COLD-FORMED SHEAR WALLS, COLD-FORMED SUPPLIER SHALL DESIGN ANCHORAGE TO SLAB AND BETWEEN FLOORS FOR HOLD DOWN FORCES INDICATED IN SCHEDULE.
6. ALTERNATE HOLD DOWNS MUST BE SUBMITTED TO THE STRUCTURAL ENGINEER OF RECORD FOR APPROVAL PRIOR TO CONSTRUCTION. HOLD DOWNS MUST MEET THE SCHEDULED FORCE CRITERIA.
7. SEE TYPICAL HOLD DOWN DETAILS FOR ANCHORAGE REQUIREMENTS AT BASE MATERIAL.
8. SEE TYPICAL HOLD DOWN ANCHOR DETAIL FOR ADDITIONAL INFORMATION AT WOOD-FRAMED WALLS.
9. SEE WOOD SHEAR WALL CONSTRUCTION SCHEDULE FOR ADDITIONAL INFORMATION.
10. ALL HOLD DOWNS MUST STACK VERTICALLY UP THE BUILDING. ADD FULL HEIGHT STUDS AS NECESSARY AT UPPER LEVELS TO ALIGN HOLD DOWNS WITH THE LEVEL BELOW.

1 S405 WOOD SHEAR WALL HOLD DOWN SCHEDULE
NO SCALE

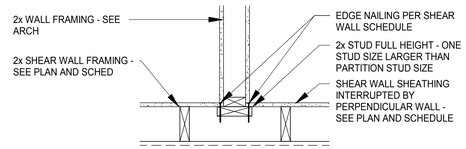


TYPICAL FASTENER REQUIREMENTS | HILTI X-CP SHANK FASTENER | ADHESIVE ANCHOR

CONCRETE SCREW ANCHOR | CAST-IN THREADED ROD | EXPANSION ANCHOR

NOTES:
1. PROVIDE 4" MINIMUM EDGE DISTANCE TO FASTENER AT SLAB EDGE PERPENDICULAR TO WALL.
2. SEE WOOD SHEAR WALL BASE CONNECTION SCHEDULE FOR ANCHOR SIZE, EMBEDMENT AND SPACING REQUIREMENTS.
3. DO NOT DAMAGE PT REINFORCING. SELECT FASTNERS WITH EMBEDMENT DEPTHS THAT WILL NOT DAMAGE PT TENDONS. VERIFY TENDON LOCATION PRIOR TO INSTALLATION.

2 S405 TYPICAL WOOD SHEAR WALL BASE CONNECTIONS DETAILS AT CAST-IN-PLACE CONCRETE
NO SCALE



SINGLE WALL TO SHEAR WALL

3 S405 TYPICAL WALL TO SHEAR WALL INTERSECTION PLAN DETAILS
NO SCALE

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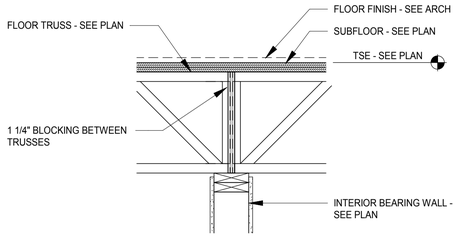
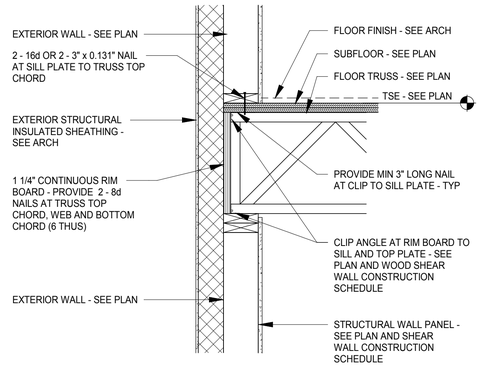
S405



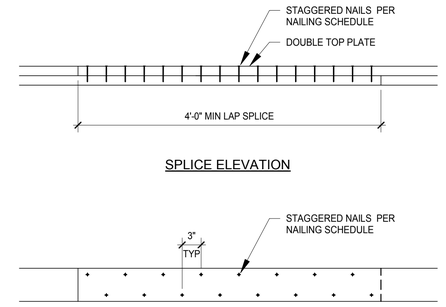
1 S701 TYPICAL WOOD TRUSS END BEARING AT INTERIOR 2x6 LOAD BEARING WALL DETAIL

NO SCALE



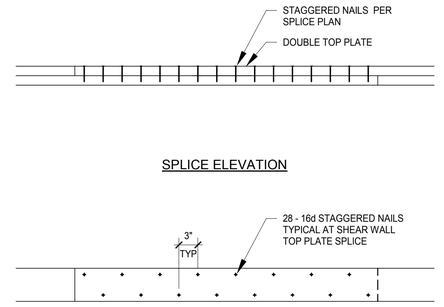
2 S701 TYPICAL WOOD TRUSS PERPENDICULAR TO EXTERIOR WALL DETAIL

NO SCALE



3 S701 TYPICAL WOOD WALL TOP PLATE LAP SPLICE NAILING DETAIL

NO SCALE



4 S701 TYPICAL SHEAR WALL TOP PLATE LAP SPLICE NAILING DETAIL

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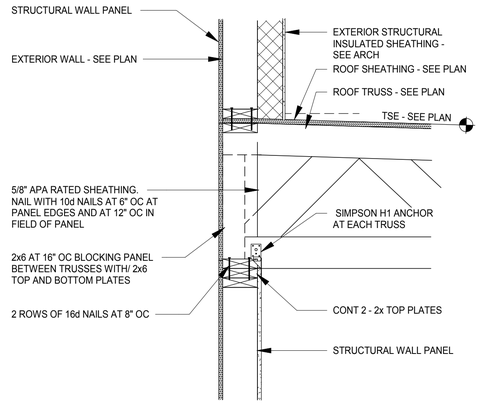
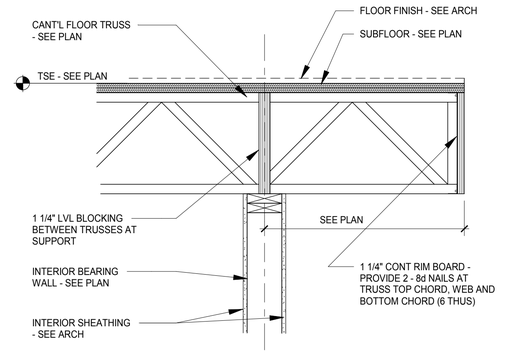


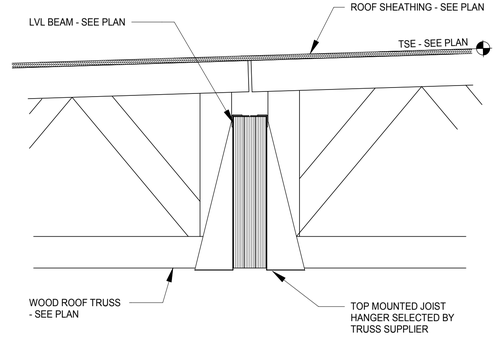
5 S701 SECTION

1" = 1'-0"



6 S701 SECTION AT CANTILEVERED WOOD TRUSS

1" = 1'-0"



7 S701 SECTION

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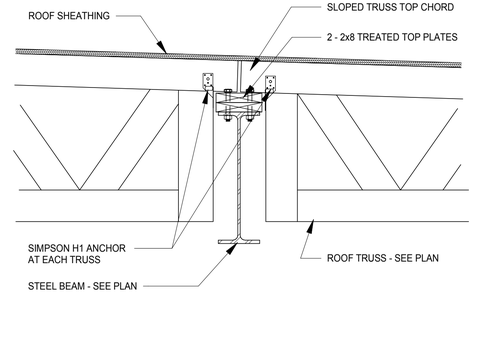
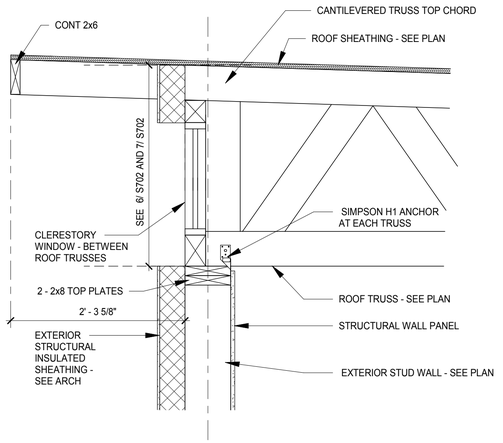


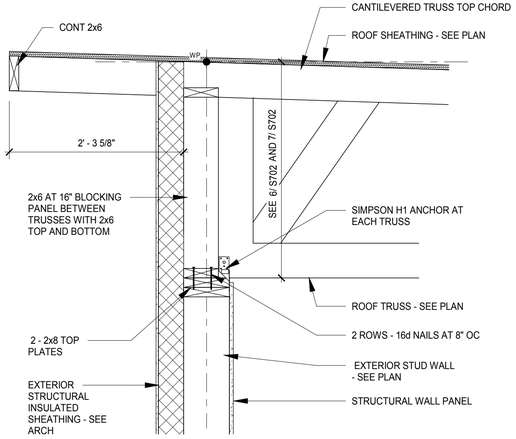
8 S701 SECTION

1" = 1'-0"



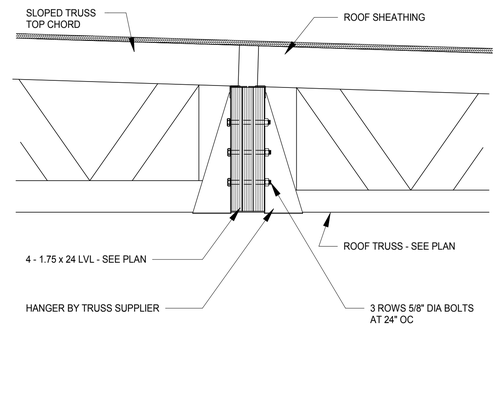
9 S701 SECTION

1" = 1'-0"



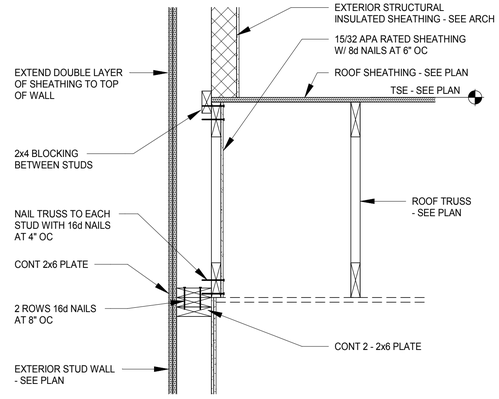
10 S701 SECTION

1" = 1'-0"



11 S701 SECTION

1" = 1'-0"



12 S701 SECTION

1" = 1'-0"

ThreeRivers PARK DISTRICT

in partnership with

Scott County

CONSULTANT:

OERTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

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FAX: 612.337.5325 SUITE 900
www.mjseng.com MINNEAPOLIS, MN 55402
SEE STRUCTURE.

REVISION / ISSUE:

NO.	DATE	DESCRIPTION
	07/24/19	CONSTRUCTION DOCUMENTS

PROJECT NAME:

CLEARY LAKE REGIONAL PARK MAINTAINANCE BLDG

6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

SIGNATURE:

ROBERT C CHILSON
NAME

40856 LICENSE #

07/24/19 DATE

PROJECT NUMBER: 19.483.0

DATE OF ISSUE: 07/24/19

DRAWN BY: DJL

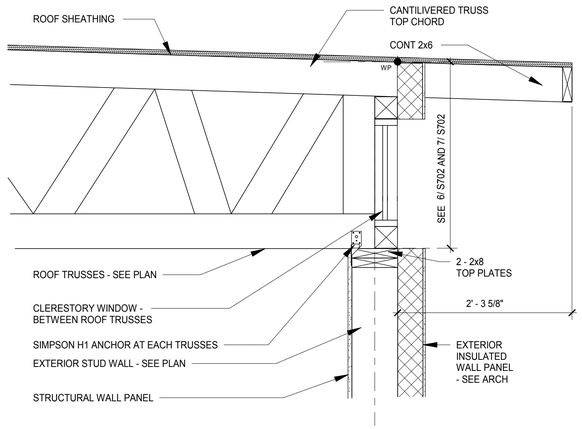
CHECKED BY ED

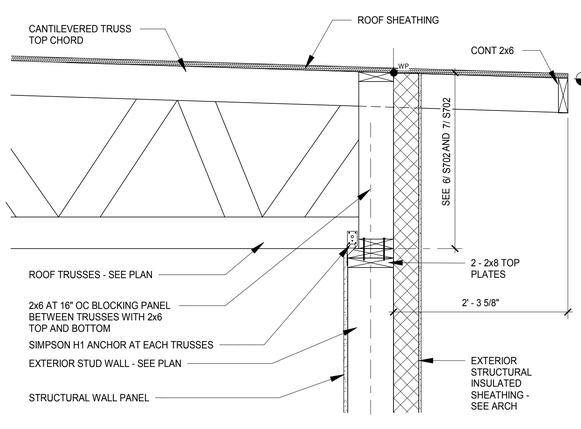
SHEET NAME:

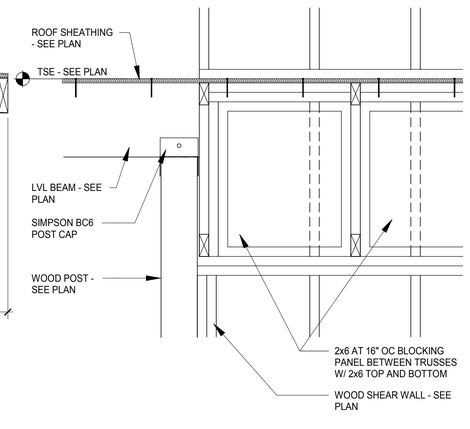
FRAMING DETAILS

SHEET NO:

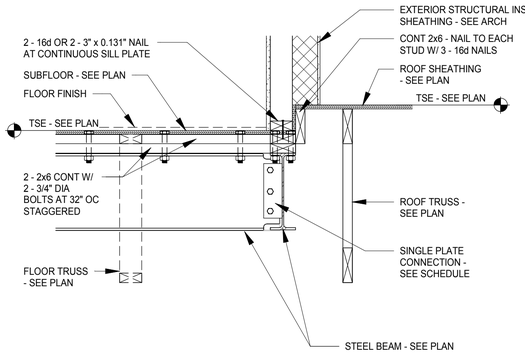
S701



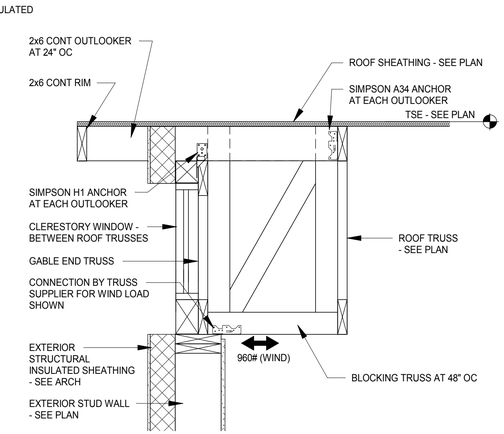




1 S702 SECTION
1" = 1'-0"



2 S702 SECTION
1" = 1'-0"



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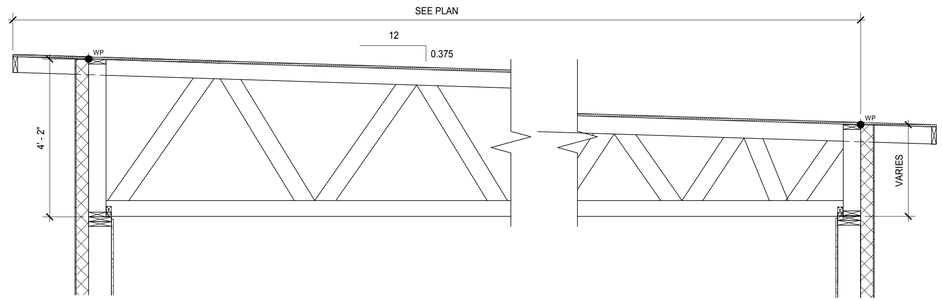
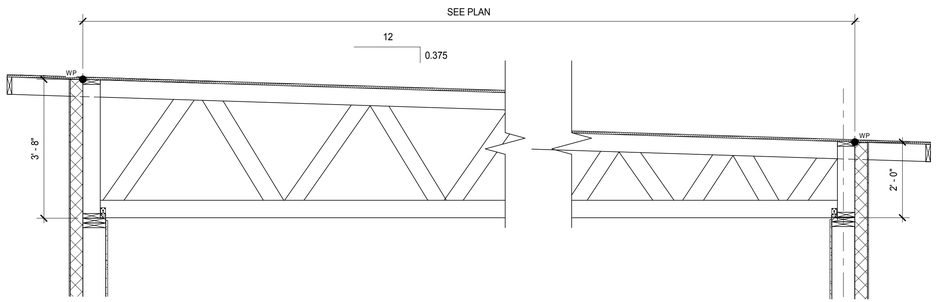
1" = 1'-0"

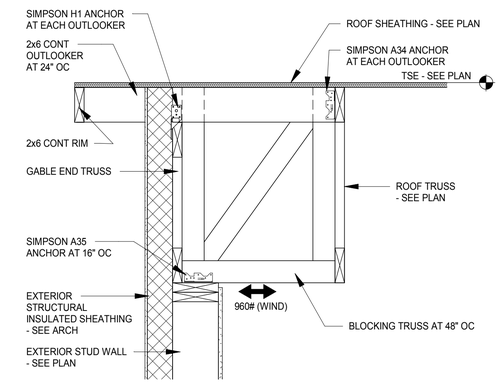


4 S702 SECTION
1" = 1'-0"

5 S702 SECTION
1" = 1'-0"

6 S702 LOW ROOF TRUSS PROFILE
1/2" = 1'-0"





7 S702 HIGH ROOF TRUSS PROFILE
1/2" = 1'-0"

8 S702 SECTION
1" = 1'-0"

ThreeRivers PARK DISTRICT
in partnership with
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CHECKED BY: ED

SHEET NAME:
FRAMING DETAILS

SHEET NO:
S702

MECHANICAL ABBREVIATIONS

ABV	ABOVE	HWR	HOT WATER RETURN
AFF	ABOVE FINISHED FLOOR	HWS	HOT WATER SUPPLY
AFG	ABOVE GRADE		
AHAP	AS HIGH AS POSSIBLE	IN	INCH
ARCH	ARCHITECT	INSUL	INSULATION
		INV	INVERT
B	BOILER		
BLDG	BUILDING	JTS	JOISTS
BO	BLOW OFF		
B.O.P.	BOTTOM OF PIPE	MAX	MAXIMUM
BSMT	BASEMENT	MC	MECHANICAL CONTRACTOR
BTWN	BETWEEN	MECH	MECHANICAL
BTWN JTS	BETWEEN JOISTS	MED	MEDIUM
		MEZZ	MEZZANINE
CAB	CABINET	MFGR	MANUFACTURER
CB	CATCH BASIN	MIN	MINIMUM
CBD	CONTINUOUS BLOW DOWN	MTD	MOUNTED
CFCI	CONTRACTOR FURNISHED & INSTALLED		
CLG	CEILING	NTS	NOT TO SCALE
CO	CLEAN OUT		
CONC	CONCRETE	OA	OUTSIDE AIR
COND	CONDENSATE	OFCI	OWNER FURNISHED, CONTRACTOR INTSALLED
CONN	CONNECTION	OPNG	OPENING
CONT	CONTINUATION	OSD	OVERFLOW STORM DRAIN
CONTR	CONTRACTOR		
CRD	CEILING RAD. DAMPER	P	PUMPS
CW	COLD WATER	PD	PRESSURE DROP
		PLBG	PLUMBING
DBJ	DUCT BETWEEN JOISTS	PRESS	PRESSURE
DIA	DIAMETER	PRV	POWER ROOF VENTILATOR
DMPR	DAMPER	PT	POINT
DN	DOWN		
DP	DEEP	RAD	RADIATION
DRWG	DRAWING	RD	ROOF DRAIN
DS	DOWN SPOUT	REF	REFERENCE
DSN	DOWN SPOUT NOZZLE	REFRIG	REFRIGERATION
		REG	REGISTER
EA	EACH	REQ'D	REQUIRED
EC	ELECTRICAL CONTRACTOR	RET	RETURN
EL	ELEVATION	RIC	RETURN IN COVER
ELEC	ELECTRICAL		
ENT	ENTERING	SAN	SANITARY
ER	EXHAUST REGISTER	SD	STORM DRAIN
EXIST	EXISTING	SCV	SELF CONTAINED VALVE
(F.)	FIELD VERIFY	SHT	SHEET
FBD	FREE BLOW DRAIN	SP	STATIC PRESSURE
FD	FIRE DAMPER/FLOOR DRAIN	SUP	SUPPLY
FLEX	FLEXIBLE	SV	SAFETY VALVE
FLR	FLOOR		
FM	FROM	TA	TRANSFER AIR
		TC	TEMPERATURE CONTROL
GA	GAUGE	TEMP	TEMPERATURE
GC	GENERAL CONTRACTOR	TFGT	TOP OF FOOTING
GEN	GENERAL	TTJ	TIGHT TO JOISTS
GPM	GALLONS PER MINUTE	TWJ	THRU WEB OF JOISTS
		TYP	TYPICAL
HB	HOSE BIB		
HORIZ	HORIZONTAL	V	VENT
HV	HAND VALVE	VD	VOLUME DAMPER
HW	HOT WATER	VEH	VEHICLE
		VEST	VESTIBULE
		VIB	VIBRATION
		VTR	VENT THRU ROOF
		W/	WITH
		WH	WALL HYDRANT

MECHANICAL SYMBOLS

PLUMBING

DESCRIPTION	SYMBOL
ACID VENT	AV
ACID WASTE, ABOVE GRADE	AW
ACID WASTE, BELOW GRADE	AW
CIRCULATING HOT WATER	
COLD WATER	
COMPRESSED AIR	CA
FUEL OIL RETURN	FOR
FUEL OIL SUPPLY	FOS
NATURAL GAS	G
HOT WATER	
INDIRECT DRAIN LINE	ID
INTERRUPTIBLE GAS	IG
IRRIGATION WATER SUPPLY	IRR
LABORATORY COMPRESSED AIR	LA
LIQUIFIED PETROLEUM GAS	LPG
MEDICAL COMPRESSED AIR	MA
MEDICAL VACUUM	VAC
NITROGEN	N
NITROUS OXIDE	NO
OXYGEN	O
SOFTENED COLD WATER	SCW
SANITARY DRAIN, ABOVE GRADE	
SANITARY DRAIN, SEWER BELOW GRADE	
STORM DRAIN, ABOVE GRADE	SD
STORM DRAIN, SEWER BELOW GRADE	SD
VENT PIPE	
140°F CIRCULATING HOT WATER	140°
140°F HOT WATER	140°
180°F CIRCULATING HOT WATER	180°
180°F HOT WATER	180°
CATCH BASIN	
CLEAN OUT	
FLOOR CLEAN OUT	
FLOOR DRAIN	
ROOF DRAIN	

FIRE PROTECTION

DESCRIPTION	SYMBOL
DRY FIRE SPRINKLER LINE	DFS
DRY STANDPIPE	DSP
FIRE PROTECTION LINE, OUTSIDE BUILDING	FP
FIRE SPRINKLER LINE	F
FIRE HOSE CABINET, RECESSED MOUNTED	FHC
FIRE HOSE CABINET, SURFACE MOUNTED	FHC
WET STANDPIPE	WSP
FIRE HYDRANT WITH SHUTOFF VALVE	
PENDANT HEAD SPRINKLER	
SIDEWALL SPRINKLER HEAD	
UPRIGHT SPRINKLER HEAD	
TWO CONNECTION FIRE DEPARTMENT CONNECTION	
THREE CONNECTION FIRE DEPARTMENT CONNECTION	
FOUR CONNECTION FIRE DEPARTMENT CONNECTION	

HEATING, VENTILATING AND AIR CONDITIONING

DESCRIPTION	SYMBOL
BOILER FEED LINE	BF
CONDENSATE DRAIN	CD
CONDENSER WATER RETURN	CDR
CONDENSER WATER SUPPLY	CDS
CHILLED WATER RETURN	CHWR
BUILDING CHILLED WATER RETURN	CHWR(B)
CHILLED WATER REVERSE RETURN	CHWRR
CHILLED WATER SUPPLY	CHWS
BUILDING CHILLED WATER SUPPLY	CHWS(B)
CONDENSATE RETURN - HIGH PRESSURE STEAM	CR(HPS)
CONDENSATE RETURN - LOW PRESSURE STEAM	CR
CONDENSATE RETURN - MEDIUM PRESSURE STEAM	CR(MPS)
GLYCOL CONDENSER RETURN	GCDR
GLYCOL CONDENSER SUPPLY	GCDS
REFRIGERANT HOT GAS	HG
HIGH PRESSURE STEAM	HPS
HEAT PUMP WATER RETURN	HPWR
HEAT PUMP WATER SUPPLY	HPWS
HEATING WATER RETURN	HWR

HEATING, VENTILATING AND AIR CONDITIONING

DESCRIPTION	SYMBOL
HEATING WATER REVERSE RETURN	HWRR
HEATING WATER SUPPLY	HWS
REFRIGERANT LIQUID	LIQ
LOW PRESSURE STEAM	LPS
MEDIUM PRESSURE STEAM	MPS
PUMPED CONDENSATE RETURN: LOW PRESSURE STEAM	PCR
PUMPED CONDENSATE RETURN: HIGH PRESSURE STEAM	PCR(HPS)
THERMOSTAT, ELECTRIC	E
HUMIDISTAT	H
THERMOSTAT, NIGHT	N
THERMOSTAT, PNEUMATIC	P
SUPPLY AIR	
RETURN AIR	
EXHAUST AIR	
SUPPLY AIR DUCT	
RETURN OR EXHAUST AIR DUCT SECTION	
OUTSIDE AIR DUCT SECTION	OA
AUTOMATIC FIRE DAMPER	FD
BACKDRAFT DAMPER	BD
MANUAL VOLUME DAMPER	
MOTORIZED DAMPER	M
AUTOMATIC SMOKE DAMPER	S
AUTOMATIC FIRE/SMOKE DAMPER	FS

VALVES

DESCRIPTION	SYMBOL
ANGLE VALVE	
BALL VALVE	
BUTTERFLY VALVE	
CONTROL VALVE	
GAS COCK VALVE	
BACKWATER VALVE	
GLOBE VALVE	
GAS PRESSURE REGULATOR VALVE	
WALL HYDRANT OR HOSE BIBB	
OS & Y VALVE	
PRESSURE REDUCING VALVE	
REFRIGERANT EXPANSION VALVE	
RELIEF VALVE	
SQUARE HEAD BALANCING COCK VALVE	
SHUTOFF VALVE	
SOLENOID VALVE	S
TWO WAY CONTROL VALVE	
THREE WAY CONTROL VALVE	
REDUCED PRESSURE BACKFLOW PREVENTOR	

PIPING CONNECTIONS

DESCRIPTION	SYMBOL
BRANCH CONNECTION OUT OF BOTTOM	
BRANCH CONNECTION OUT OF TOP	
CHECK VALVE	
COMBINATION WYE & 1/8 BEND	
COMBINATION WYE & 1/8 BEND	
ELBOW DOWN	
ELBOW UP	
45° ELBOW	
90° ELBOW	
TEE CONNECTION	
TEE CONNECTION DOWN	
TEE CONNECTION UP	
WYE, BEND	
WYE, SINGLE	
WYE, DOUBLE	

MISCELLANEOUS

DESCRIPTION	SYMBOL
PIPE ANCHOR	
AQUASTAT	T
AIR VENT	
GENERIC STEAM TRAP	
CAPPED LINE	
CONCENTRIC REDUCER	
STRAINER, DUPLEX	
ECCENTRIC REDUCER	
EXPANSION JOINT	
FLEXIBLE CONNECTOR	
FLOW FITTING	
FLOW	
FLOW SWITCH	
PIPE GUIDE	
DIRECTION OF PITCH DOWN	
PRESSURE/TEMPERATURE FITTING	
PUMP (DIAGRAMMATIC)	
PRESSURE GAUGE WITH VALVE	
PRESSURE GAUGE WITH VALVE & SIPHON	
POINT OF CONNECTION	
POINT OF DEMOLITION	
SIGHT GLASS	
SHOCK ABSORBER STRAINER	
THERMOMETER	
UNION	

HVAC GENERAL NOTES:

A. All ductwork shall be fabricated, installed and supported in accordance with chapter 6 of the 2012 International Mechanical Code and associated 2015 Minnesota amendments, the most current ASHRAE and SMACNA standards and the mechanical specifications for this project.

B. Provide adequate support and vibration isolation for all mechanical equipment and systems furnished and installed as part of the mechanical work. All mechanical equipment shall be supported from the building structure in accordance with code compliant and recognized industry standard methods. No ductwork or piping shall be supported from other ductwork, piping or conduit.

C. Refer to the architectural drawings for locations of all fire rated walls, ceilings and floors. Where mechanical systems penetrate rated walls, ceilings and floors, maintain the indicated rating with specification and code approved fire sealing materials.

D. Refer to the architectural reflected ceiling plans for ceiling types, heights, and exact locations of all diffusers, grilles, registers, lights, and ceiling mounted equipment. Coordinate air terminal device layout with other ceiling equipment and ceiling architectural features.

E. Coordinate construction openings necessary for the proper installation of mechanical systems with the general contractor. Do not cut new, pre-stressed or post-tensioned concrete floors or structural members without first consulting the architect or structural engineer. Coordinate roof openings with general contractor prior to ordering and setting rooftop equipment.

F. Provide sleeves for all ductwork and piping penetrations of walls and floors. Maintain respective wall and ceiling ratings at all mechanical penetrations.

G. Ductwork dimensions are inside clear airflow dimensions. Increase lined ductwork dimensions accordingly.

H. Contractor may substitute spiral ductwork in lieu of rectangular ductwork sizes.

J. Provide a manual volume balancing damper on each branch duct that serves a diffuser or register.

K. Provide flexible connections at the air inlet and outlet of each fan unit or device.

L. Mount thermostats and wall switches at 54-inches above finished floor unless indicated otherwise. Refer to the HVAC drawings for locations.

M. The project mechanical drawings are symbolic and diagrammatic and are intended to show only the general scheme, equipment involved, and the approximate locations of materials and equipment.

N. The project mechanical drawings and specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified shall be provided or performed as though mentioned and indicated in both the drawings and specifications. If items indicated on the drawings appear to conflict with other items indicated on the drawings or with the specifications, then the item or statement requiring the greater quantity, superior quality, or condition most favorable to the owner shall take precedence.

O. Refer also to plumbing and lighting plans for coordination and to the project mechanical specifications for further information and additional requirements.

Mechanical Sheet Index	
M0.0	MECHANICAL TITLE SHEET
M1.0	UNDERGROUND PLUMBING PLAN
M2.0	PLUMBING PLAN
M3.0	HVAC PLAN
M4.0	PLUMBING RISER DIAGRAMS
M5.0	MECHANICAL DETAILS
M5.1	MECHANICAL DETAILS
M6.0	MECHANICAL SCHEDULES

PLUMBING GENERAL NOTES:

A. Provide all equipment, piping, controls, components, specialties and accessories necessary for complete and fully functioning mechanical systems whether or not specifically shown on the drawings. Secure all permits and pay all fees in connection with the mechanical work.

B. Provide timely and proper layout of mechanical equipment and systems. Coordinate mechanical work with work of other trades prior to ordering equipment, beginning system fabrication, and beginning installation. Keep all plumbing piping runs as high as possible. Maintain proper burial depths for all utility service piping.

C. Coordinate all plumbing piping runs with building structure, ductwork and lights. Offset plumbing piping as required for a coordinated and proper system installation. Pitch sanitary and storm drainage piping at 1/4-inch per foot where possible and 1/8-inch per foot minimum unless indicated otherwise on the drawings or required by applicable codes. Where invert elevations are given, the piping shall pitch on an even grade between two given elevations.

D. Provide adequate support and vibration isolation for all mechanical equipment and systems furnished and installed as part of the mechanical work. All mechanical equipment shall be supported from the building structure in accordance with code compliant and recognized industry standard methods. No piping shall be supported from other piping, ductwork or conduit.

E. Refer to the architectural drawings for locations of all fire rated walls, ceilings and floors. Where mechanical systems penetrate rated walls, ceilings and floors, maintain the indicated rating with specification and code approved fire sealing materials.

F. Provide sleeves for all piping penetrations of walls and floors.

G. All plumbing piping shall be installed in accordance with the most current adopted Minnesota state plumbing code. Refer to Minnesota rules, chapter 4714..

H. Work performed and materials used for the plumbing system shall comply with the standards set in the Minnesota state plumbing code. Refer to Minnesota rules, chapter 4714.
.

I. The domestic water piping system shall be disinfected in accordance with the requirements of the Minnesota state plumbing code. Refer to Minnesota rules, chapter 4714.

J. The plumbing system shall be tested in accordance with the requirements of the Minnesota state plumbing code. Refer to Minnesota rules, chapter 4714.

K. Plastic pipe must be furnished and installed in accordance with Minnesota state plumbing code requirements. Refer to Minnesota rules, chapter 4714. Above grade horizontal runs of plastic waste and vent pipe cannot exceed 35-feet in total length.

L. Joints in PVC and CPVC pipe must include use of a primer which is of contrasting color to the pipe and cement. Refer to Minnesota rules, chapter 4714.

M. All solder and flux used for potable domestic water distribution systems shall contain less than 0.2 percent lead. Use of 50-50 solder or flux containing more than 0.2 percent lead is prohibited in potable domestic water distribution systems. Any solder other than 95-5 tin-antimony or 96-4 tin-silver must be specifically approved by the governing administrative authority prior to use on this project. Minnesota rules, chapter 4714.

N. Information indicated on the drawings regarding utility service pressures, locations, invert elevations, and materials, has been obtained from a representative of the utility at the time of design. Verify such information prior to fabricating and installing any components associated with utility connections and notify engineer of any deviation before beginning installation of the system.

O. Refer also to the HVAC and lighting drawings for coordination and to the project mechanical specifications for further information and additional requirements.

P. It is the responsibility of the contractor/installer to notify the Minnesota department of labor and industry when an installation is ready for a state contract job, licensed facility, or project in an area where there is no local administrative authority is ready for an inspection and test.

OVERALL PROJECT MECHANICAL NOTES

A. This contractor shall visit the site and verify existing conditions and limitations prior to submitting bid and beginning work. No additional charges will be allowed due to this contractor's misunderstanding as to the amount of work involved or lack of knowledge of any condition in connection with the work.

B. Notify Building Manager prior to starting work or shutting down any systems. Obtain the assistance of the facility maintenance staff when shutting down existing mechanical and electrical systems.

C. Provide all equipment, piping, ductwork, controls, components, specialties and accessories necessary for complete and fully functioning mechanical systems whether or not specifically shown on the drawings. Secure all permits and pay all fees in connection with the mechanical work.

D. Work performed and materials used shall conform in every respect to all requirements of applicable codes, ordinances, rules, and regulations pertaining to the work. This shall not permit a lower grade of construction where the drawings or specifications call for workmanship or materials in excess of code requirements.

E. Provide timely and proper layout of mechanical equipment and systems. Coordinate mechanical work with work of other trades prior to ordering equipment, beginning system fabrication, and beginning installation.

F. Noise and vibration generated on the project site as part of fabrication and installation of the mechanical work shall be limited to levels not objectionable to occupants and not detrimental to owner operations. Coordinate with general contractor times and locations where loud work may be performed.

G. Provide adequate support and vibration isolation for all mechanical equipment and systems furnished and installed as part of the mechanical work. All mechanical equipment shall be supported from the building structure in accordance with code compliant and recognized industry standard methods.

H. Refer to the architectural drawings for locations of all fire rated walls, ceilings and floors. Where mechanical systems penetrate rated walls, ceilings and floors, maintain the indicated rating with specification and code approved fire sealing materials.

I. Coordinate construction openings necessary for the proper installation of mechanical systems with the general contractor. Do not cut new, pre-stressed or post-tensioned concrete floors or structural members without first consulting the architect or structural engineer.

J. At the end of each day's work properly remove and legally dispose of all debris, waste, rubbish, surplus materials, and similar items resulting from the work or associated operations, leaving the project site and all equipment furnished as part of the mechanical work in a clean and dust free condition. Transport debris and rubbish in such a manner as to prevent the spread of dust.

K. Execute mechanical work with care. New and existing-to-remain construction which is damaged or defaced as a result of the work and is unsuitable for the use intended shall be removed and replaced by this contractor at no additional cost to the owner.

L. The project mechanical drawings are symbolic and diagrammatic and are intended to show only the general scheme, equipment involved, and the approximate locations of materials and equipment.

M. Information indicated on the drawings regarding utility service pressures, locations, invert elevations, and materials, has been obtained from a representative of the utility at the time of design. Verify such information prior to fabricating and installing any components associated with utility connections and notify engineer of any deviation before beginning installation of the system.

N. The project mechanical drawings and specifications are to be considered as supplementing each other. Work specified but not shown, or shown but not specified shall be provided or performed as though mentioned and indicated in both the drawings and specifications. If items indicated on the drawings appear to conflict with other items indicated on the drawings or with the specifications, then the item or statement requiring the greater quantity, superior quality, or condition most favorable to the owner shall take precedence.

O. The mechanical contractor is responsible for taking down, storage and reinstallation of any existing ceiling grids, ceiling tiles, etc. as needed for installation of the new mechanical systems. The mechanical contractor shall replace any damaged grids, tiles, etc. to match existing.

P. The mechanical contractor shall remove and reinstall any cross-bracing in the joist space that interferes with the installation of the new ductwork, piping and equipment that is to be installed with the joist spacing.

Q. The mechanical contractor shall provide all necessary offsets and/or transitions as required to install ductwork and piping in the ceiling joist space due to conflicts with existing equipment, ductwork, piping, lights and joist spacing.

R. All piping, ductwork, equipment, etc. shown screened in plans with new work is existing and is to remain unless otherwise noted.

S. Refer to the project mechanical specifications for further information and additional requirements.

T. All mechanical contractors including demo, HVAC plumbing, fire protection, controls, etc. shall review all drawings & specifications in this complete set and provide a complete system as required and not limit themselves to any specific drawing / specification section.

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in partnership with

Scott County

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Paulson & Clark Engineering
Structural | Mechanical | Electrical | Security

REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:

CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG

6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature

Travis L. Willemssen
Name

47945 — License #
July 25, 2019 — Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: JJN
CHECKED BY: TLW

SHEET NAME:

MECHANICAL TITLE SHEET

SHEET NO:

M0.0

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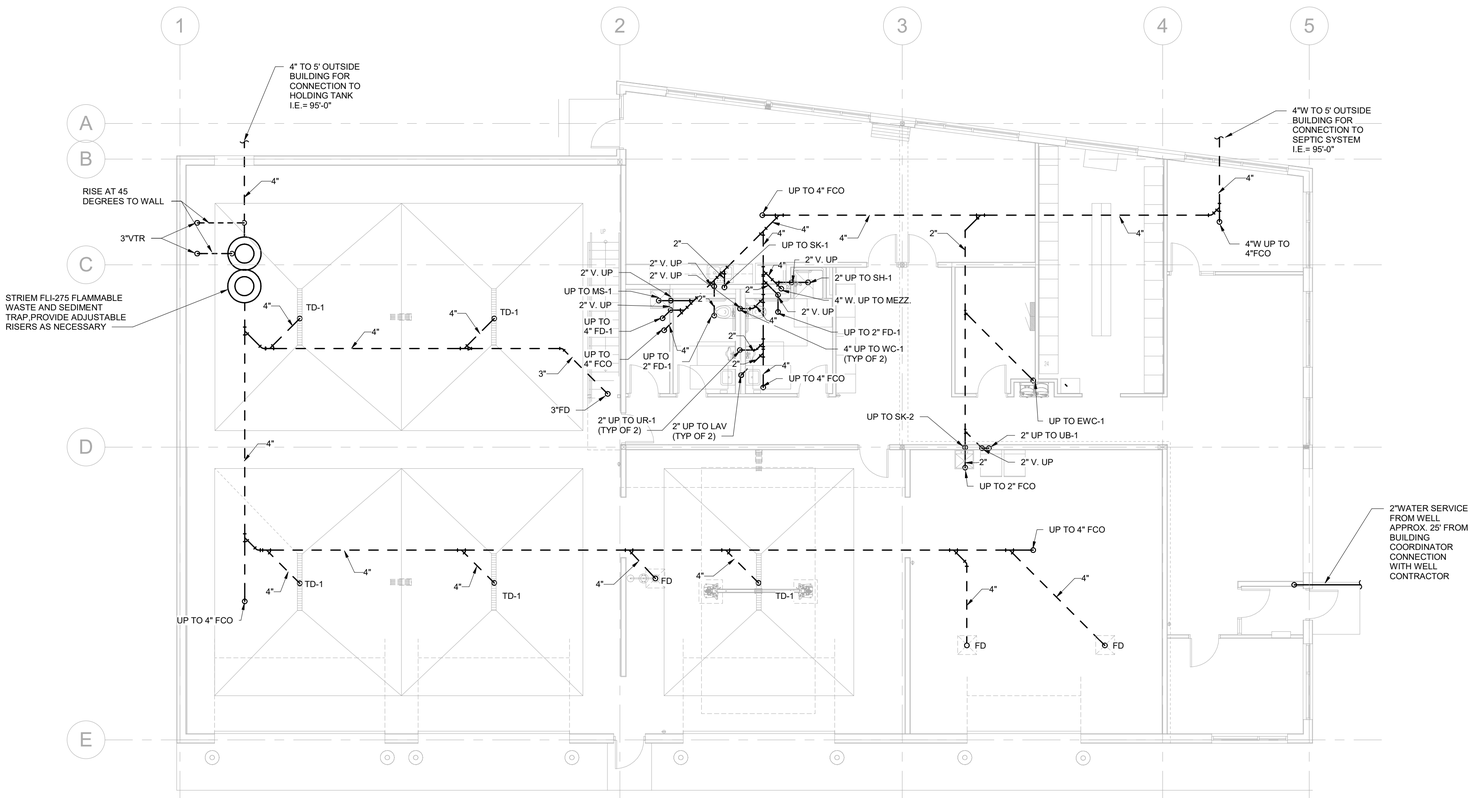

1 UNDERGROUND - PLUMBING PLAN
1/8" = 1'-0"

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SHEET NAME:

UNDERGROUND PLUMBING PLAN

SHEET NO:

M1.0

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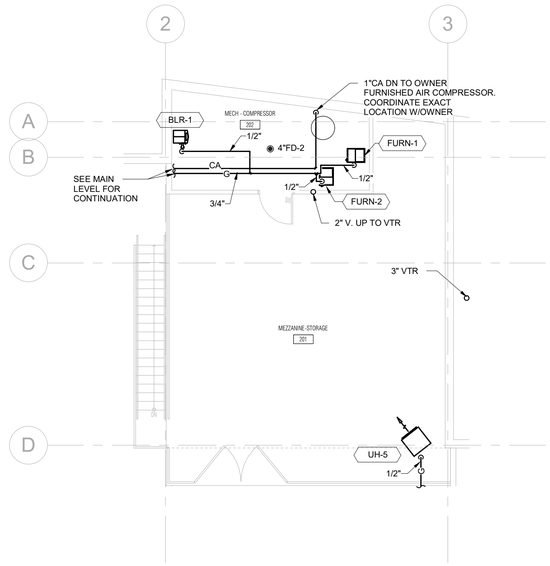
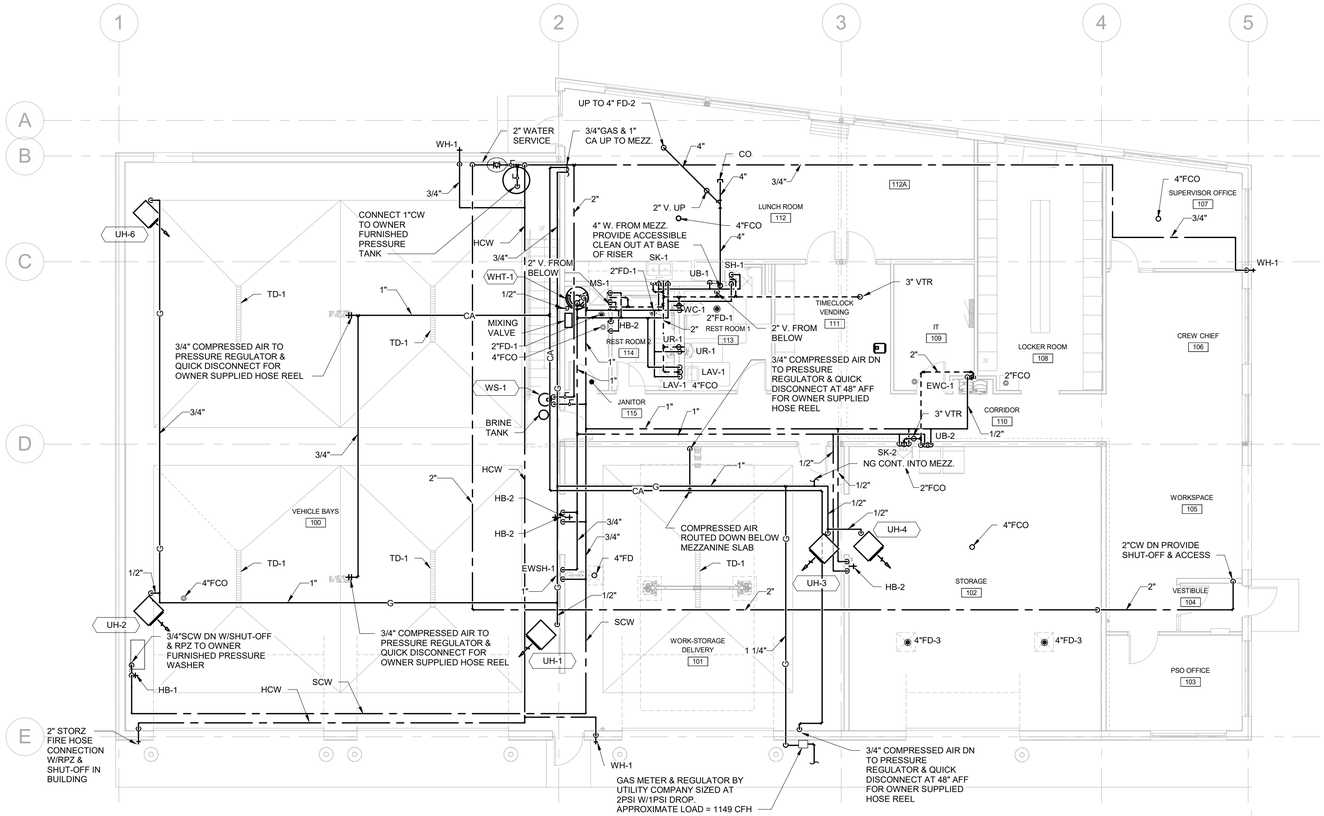


1 MEZZANINE - PLUMBING PLAN
1/8" = 1'-0"



2 MAIN LEVEL - PLUMBING PLAN
1/8" = 1'-0"

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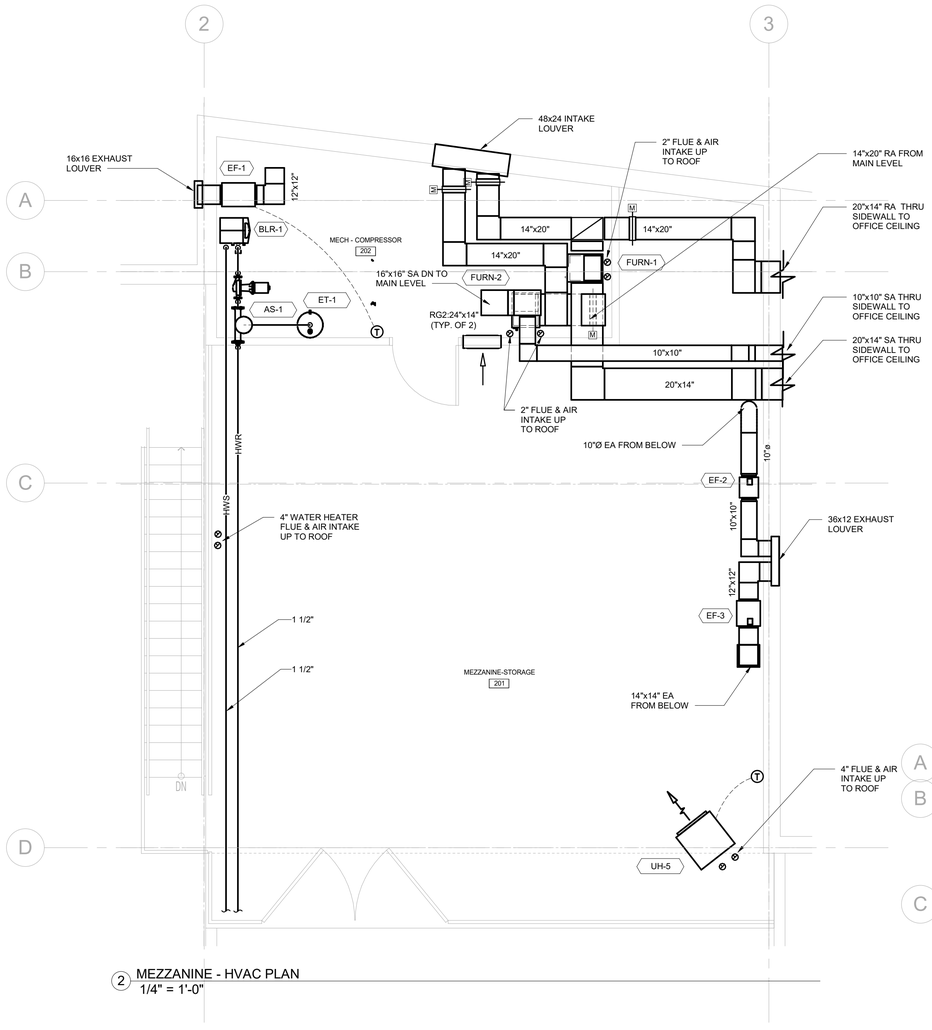
SHEET NAME:

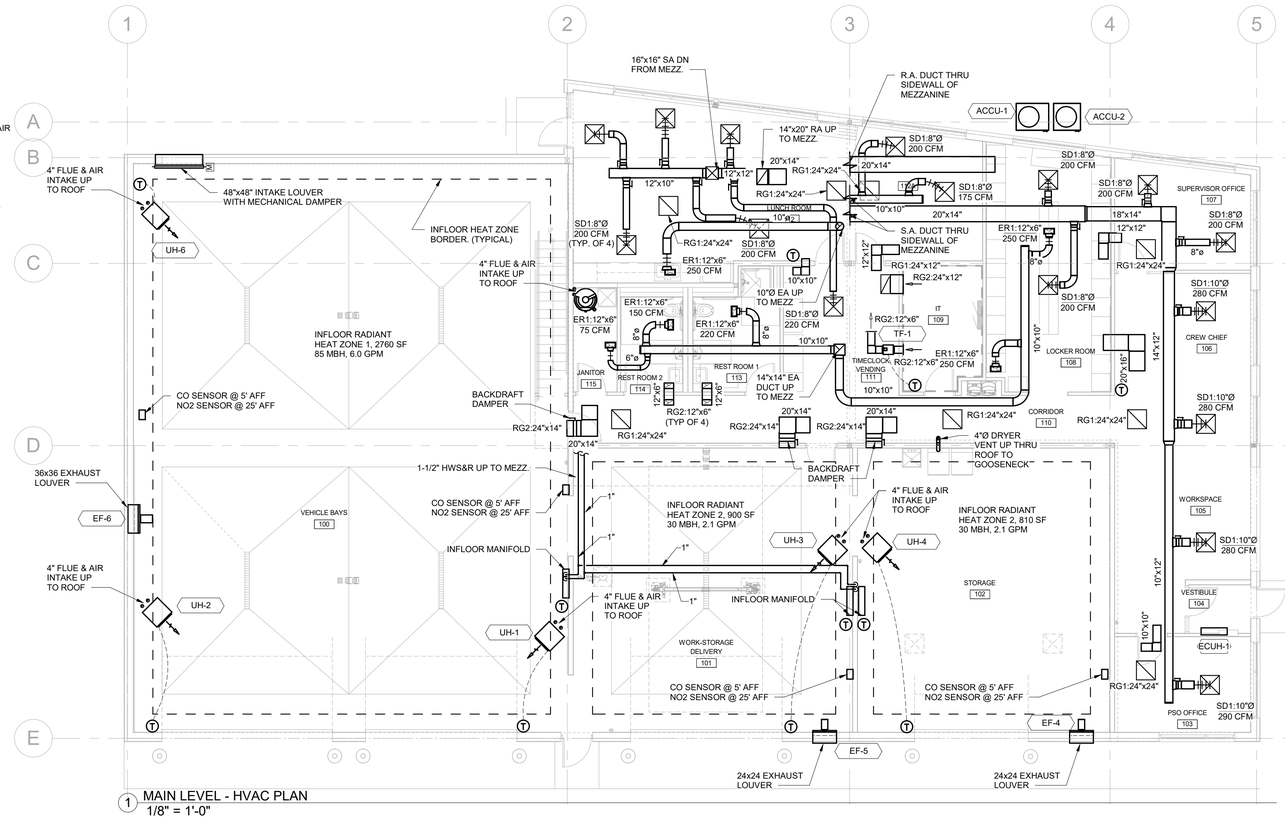
PLUMBING PLAN

SHEET NO:

M2.0



2 MEZZANINE - HVAC PLAN
1/4" = 1'-0"



1 MAIN LEVEL - HVAC PLAN
1/8" = 1'-0"

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SHEET NAME:
HVAC PLAN

SHEET NO:
M3.0

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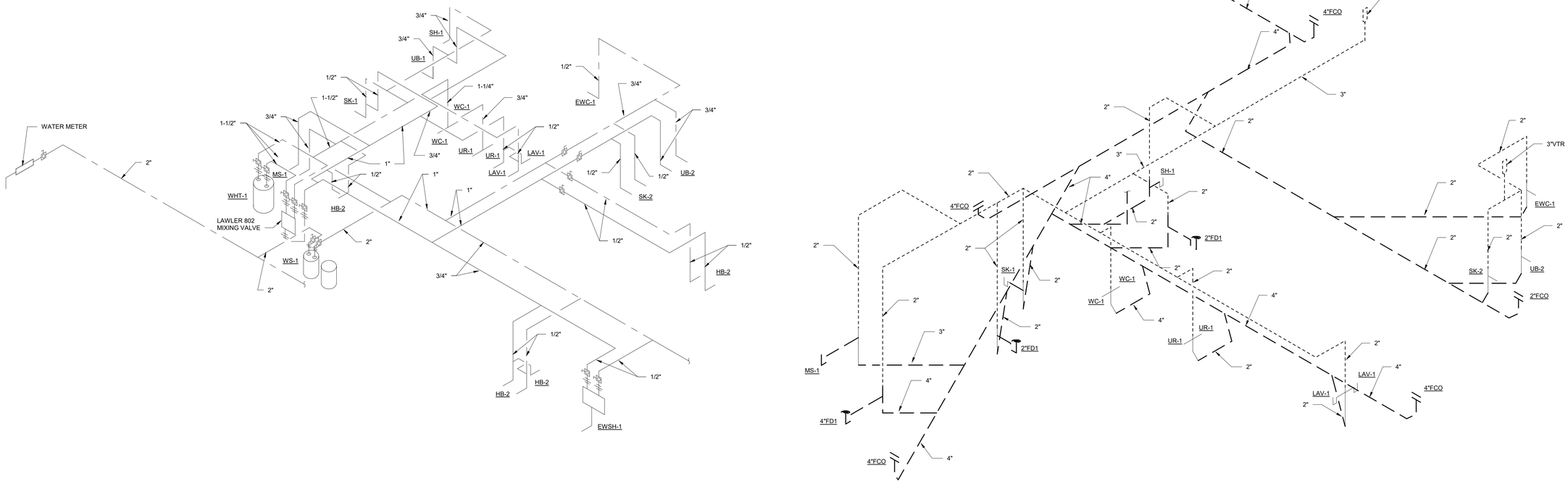

1 Domestic & Sanitary Plumbing Risers
12" = 1'-0"

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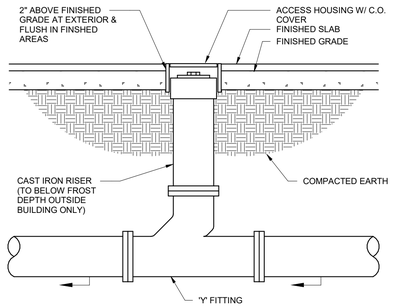
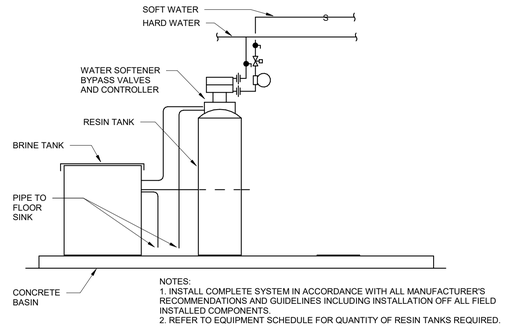
SHEET NAME:
PLUMBING RISER DIAGRAMS

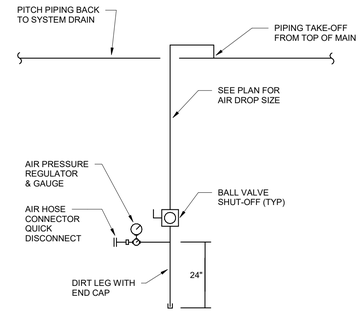
SHEET NO:
M4.0



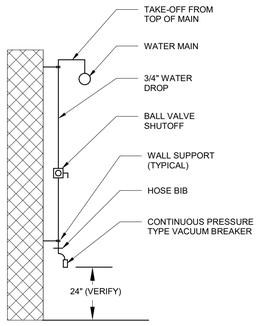
1 Typical Cleanout
NTS



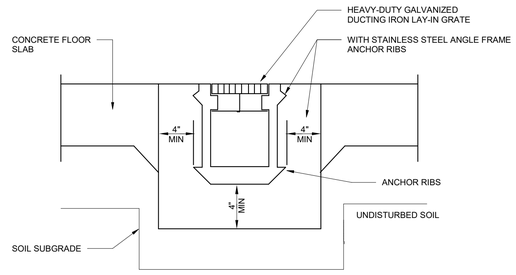
2 Water Softener
NTS



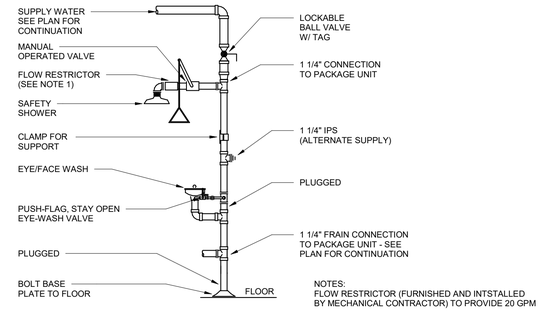
3 Air Drop Detail
NTS



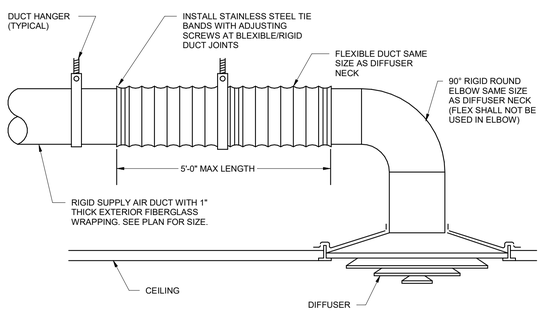
4 Water Drop Detail
NTS



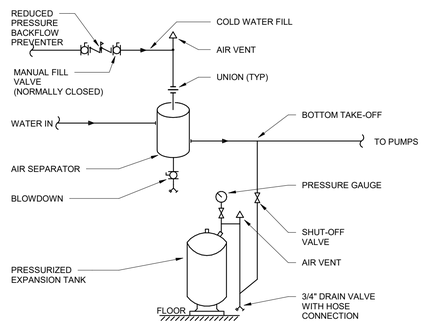
5 Polymer Trench Drain Detail
NTS



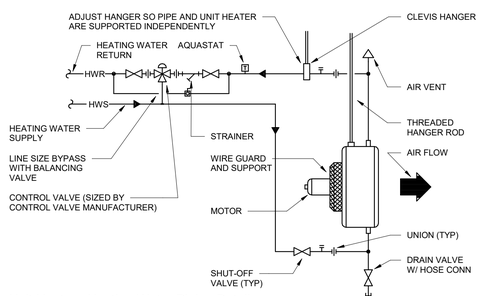
6 Package Safety Shower & Eye/Face Wash
NTS



7 Duct Connection To Diffuser
NTS



8 Air Separator and Expansion Tank
NTS



Unit Heater - Heating Water Piping Detail (3-Way Valve)
9 NTS

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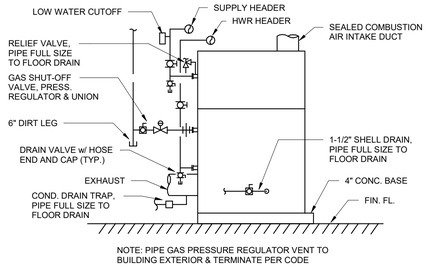
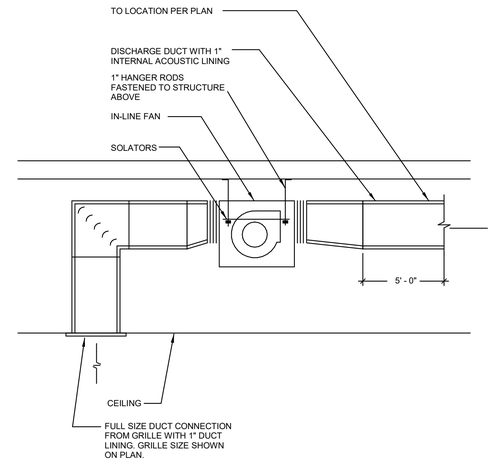
SHEET NAME:
MECHANICAL DETAILS

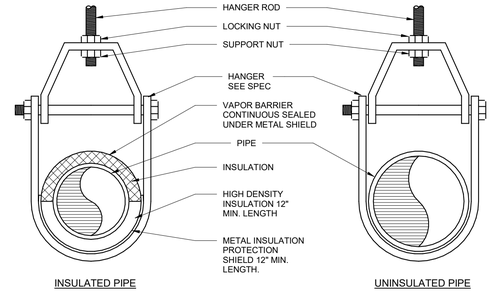
SHEET NO:
M5.0



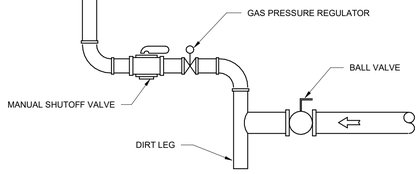
1 Condensing Boiler Piping Detail
NTS



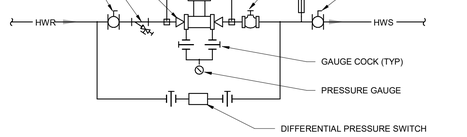
2 In-Line Cabinet Fan
NTS



3 Clevis Hanger
NTS

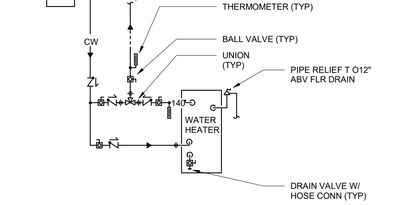


4 Gas Train Assembly
NTS



NOTES:
1. CONTRACTOR MAY ELIMINATE TRIPLE DUTY VALVE AND REPLACE WITH A SHUTOFF VALVE, FLOW FITTING, BALANCING VALVE AND A CHECK VALVE.
2. PUMP TO BE SUPPORTED INDEPENDENT OF PIPING.

5 Inline Pump Piping Detail
NTS



6 Gas Water Heater
NTS

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MECHANICAL DETAILS

SHEET NO:

M5.1

Exhaust Fan Schedule

Mark	Area Served	Manufacturer	Model	CFM	ESP	Damper	Control Voltage	Fan RPM	Sones	Electrical					Notes
										Power	Voltage	Phase	Disc. By	Starter By	
EF-1	Mechanical Room 202	Greenheck	SQ-90-VG	340 CFM	0.50 in-wg	BD	120 V	1577	7.6	Frac	120 V	1	ELEC	ELEC	1
EF-2	Mezzannine Storage	Greenheck	SQ-80-VG	250 CFM	0.50 in-wg	BD	120 V	1653	8.1	Frac	120 V	1	ELEC	ELEC	1
EF-3	Mezzanine Storage	Greenheck	SQ-99-VG	945 CFM	1.00 in-wg	BD	120 V	2188	19.8	3/4 HP	120 V	1	ELEC	ELEC	1
EF-4	Storage 102	Greenheck	SE2-16-417-A	1339 CFM	0.50 in-wg	BD	120 V	1750	17.3	1 HP	208 V	3	ELEC	ELEC	2
EF-5	Work Storage Delivery 101	Greenheck	SE2-16-417-A	1339 CFM	0.50 in-wg	BD	120 V	1750	17.3	1 HP	208 V	3	ELEC	ELEC	2
EF-6	Vehicle Bay	Greenheck	SBE-3H24	4200 CFM	0.50 in-wg	BD	120 V	1221	21	1 HP	208 V	3	ELEC	ELEC	2
TF-1	IT Room	Greenheck	CSP-A510	400 CFM	0.25 in-wg	BD	24 V	975	1.1	149 W	120 V	1	ELEC	ELEC	1

Notes:
1. Provide with EC motor, gravity backdraft damper, factory disconnect, adequate support & vibration isolation.
2. Provide with fan housing, motor guard, backdraft damper, factory disconnect, adequate support & vibration isolation.

Unit Heater Schedule

Mark	Area Served	Manufacturer	Model	Orientation	CFM	EAT	LAT	Input MBH	Output MBH	Electrical					Notes
										Power	Voltage	Phase	Starter By	Disc. By	
UH-1	Vehicle Bay	Reznor	UDAS 125	Horizontal	1537	50 °F	110 °F	125.0	99.6	1/4 HP	120 V	1	MECH	ELEC	1
UH-2	Vehicle Bay	Reznor	UDAS 125	Horizontal	1537	50 °F	110 °F	125.0	99.6	1/4 HP	120 V	1	MECH	ELEC	1
UH-3	Work Storage Delivery 101	Reznor	UDAS 45	Horizontal	629	50 °F	105 °F	45.0	37.3	Frac	120 V	1	MECH	ELEC	1
UH-4	Storage 102	Reznor	UDAS 45	Horizontal	629	50 °F	105 °F	45.0	37.3	Frac	120 V	1	MECH	ELEC	1
UH-5	Mezzanaine	Reznor	UDAS 45	Horizontal	629	50 °F	105 °F	45.0	37.3	Frac	120 V	1	MECH	ELEC	1
UH-6	Vehicle Bay	Reznor	UDAS 350	Horizontal	4483	50 °F	110 °F	350.0	290.5	1/2 HP	120 V	1	MECH	ELEC	1

Notes:
1. Provide with factory disconnect, venting kit, adequate supply & vibration isolation.

Cabinet Unit Heater Schedule

Mark	Area Served	Manufacturer	Model	Orientation	CFM	EAT	LAT	Total MBH	Electrical					Notes
									Power	Voltage	Phase	Starter By	Disc. By	
ECUH-1	Vestibule	Markel	J3326TD	Semi Recessed Wall	175	50 °F	123 °F	13.8	4kW	208 V	3	MECH	MECH	1

Notes:
1. Provide factory disconnect, built-in thermostat & semi-recessed mounting frame.

Plumbing Fixture Schedule

Fixture Tag	Fixture Type	Minimum Pipe Sizes				Notes
		Cold	Hot	Waste	Vent	
EWC-1	ADA, Dual Height Electric Water Cooler	1/2"	0"	1 1/2"	2"	ADA, Dual Heaight, Bottle Filler
EWSH-1	Emergency Eyewash/Shower	3/4"	3/4"	0"	0"	ADA, ASSE 1071 Approved Mixing Valve, Pedestal Mounted
HB-1	Hose Bibb	3/4"	0"	0"	0"	3/4" Threaded Hose Connection, Atmospheric Vacuum Breaker
HB-2	Hot and Cold Water Hose Bibb	1/2"	1/2"	0"	0"	3/4" Threaded Hose Connection, Atmospheric Vacuum Breaker
LAV-1	Wall Hung Lavatory	1/2"	1/2"	2"	2"	ADA, Battery Powered, Sensor Operated Faucet
MS-1	Mop Sink	3/4"	3/4"	3"	2"	Floor Basin, Manual Wall Mounted Faucet with Vacuum Breaker, Pail Hook and Wall Brace.
SH-1	Shower Enclosure	1/2"	1/2"	2"	2"	ADA, Barrier Free, 2" Vented Shower Drain
SK-1	Countertop Two Compartment Sink	1/2"	1/2"	2"	2"	ADA, Stainless Steel, Manual Gooseneck Faucet
SK-2	Service Sink	1/2"	1/2"	2"	2"	Floor Mounted Molded Stone, Deck Mounted Manual Faucet w/ Swing Spout
UB-1	Refrigerator Water Outlet Box	1/2"	0"	0"	0"	Galvanized Outlet Box w/ Backflow Preventer
UB-2	Washing Machine Outlet Box	3/4"	3/4"	2"	2"	Galvanized Outlet Box w/ Backflow Preventer
UR-1	Urinal	3/4"	0"	2"	2"	ADA, Wall Hung, Provide Manual Flush Valve
WC-1	Water Closet	1 1/4"	0"	4"	2"	ADA, Wall Hung, Provide Manual Flush Valve
WH-1	Wall Hydrant	3/4"	0"	0"	0"	Freezeproof, Vacuum Breaker, Loose Key

Notes:
1. Refer to architectural for exact plumbing fixture locations and mounting heights.

Air Cooled Condensing Unit Schedule

Mark	Location	Manufacturer	Model	Compressor RLA	Fan FLA	SEER	Voltage	Phase	MCA	MOCP	Starter By	Disc. By	Notes
ACCU-1	Grade	LENNOX	SSB060H4	16.5	1.8	16	208 V	3	22 A	35 A	MECH	ELEC	
ACCU-2	Grade	LENNOX	SSB048H4	14	2.8	16	208 V	3	20 A	30 A	MECH	ELEC	

Notes:
1. Provide unit base, crankcase heater, anit-short cycle time, vibration isolation adn refrigerant controls. Unit shall be UL listed. Interlock operation with associated furnace.

Furnace Schedule

Mark	Area Served	Manufacturer	Model	Fan			CFM Outdoor Air	Natural Gas Heating				DX Cooling Coil							Electrical				Notes
				CFM	HP	ESP		EAT	LAT	Input MBH	Output MBH	EDB	EWB	LDB	LWB	Total MBH	Sensible MBH	Refrigerant	Voltage	Phase	Starter By	Disc. By	
FURN-1	ZONE 2	Lennox	EL296UH090XV60C	1930	1	0.80 in-wg	400	55 °F	96 °F	88	85	80 °F	67 °F	57 °F	56 °F	60	48	R410A	120 V	1	MECH	ELEC	1
FURN-2	ZONE 1	Lennox	EL296UH090XV48C	1595	.75	0.80 in-wg	320	55 °F	96 °F	88	85	80 °F	67 °F	58 °F	57 °F	48	38	R410A	120 V	1	MECH	ELEC	1

Notes:
1. Provide side return, filter rack with filter, cased cooling coil section with coil, vent kit, flexible connectors at fan supply and return, motor starter, control transformer. Pipe condensate to floor drain.

Boiler Schedule

Mark	Location	Manufacturer	Model	Type Comments	Input MBH	Output MBH	Fuel	Efficiency	Electrical				Notes
									Voltage	Phase	Starter By	Disc. By	
BLR-1	Mezzanaine	Lochinvar	WHB199	Condensing	189	199	Natural Gas	93	120 V	1	MECH	ELEC	1

Notes:
1. Provide water temperature sensors, electronic control panel, modulating control, vent piping, temperature & pressure relief, low water cutoff and all necessary safeties and accessories. Pipe condensate to floor drain thru neutralization kit. Provide economizer control.
2. Provide with 30% propylene glycol.

Pump Schedule

Mark	Area Served	Manufacturer	Pump Type	Model	GPM	Pump Head (FT)	Pump RPM	Electrical					Notes
								Power	Voltage	Phase	Starter By	Disc. By	
P-1	Infloor Heat	Bell & Gossett	In-Line Mounted	Ecocirc 65-130	12 GPM	50	3096	1 HP	208 V	3	MECH	ELEC	1

Notes:
1. Provide EC motor and built-in controls.

Floor Drain Schedule

Fixture Tag	Fixture Type	Minimum Pipe Sizes		Comments
		Waste Size	Vent Size	
2"FD-1	Toilet Room Type	2"	2"	
4"FD-2	Mechanical Room Type	4"	2"	
4"FD-3	Vehicle Area Type	4"	2"	

Gas Fired Water Heater Schedule

Mark	Manufacturer	Model	Volume	MBH	Recovery	Electrical		Notes
						Voltage	Phase	
WHT-1	A.O. Smith	BTH-250	100.0 gal	250	291 gal/h	120 V	1	1,2

Notes:
1. Tank type gas fired water heater. Provide temperature/pressure saftey relief, 27" heat trap and modulating control. pipe relief to floor drain.
2. Provide concrete house keeping pad 6 inches wider and longer than equipment provided.

Air Terminal Schedule

Mark	Description	Manufacturer	Model	Finish	Notes
ER1	Exhaust Air Register 35° Deflection	Titus	350RL	White	1
RG1	Eggcrate Return Grille	Titus	50F	White	1
RG2	Return Grille 35° Deflection	Titus	350RL	White	1
SD1	24"x24" Square Cone Diffuser	Titus	TMS	White	1

Notes:
1. Refer to architectural ceiling plans for border types.

Water Softener Schedule

Mark	Manufacturer	Model	Grain Capacity	Regen. Qty. (CU.FT.)	Maximum Flow Rate (GPM)	Backwash Rate (GPM)	Brine Tank Salt Capacity	Notes
WS-1	Water Control Corporation	MF-48-MR	48,000	1.5	42	3.5	300 lbs.	1

Notes:
1. Automatic controls. Motor driven, mechanically activated control valve shall be all brass construction. 1 1/2 inch npt inlets and outlets. Provide 6 foot long 120/VAC power cord. Pipe discharge to floor drain.

Storage Tank Schedule

Mark	Location	Type	Manufacturer	Model	Tank Volume	Diameter	Height	Flooded Weight	Notes
ET-1	Mezzanaine	Pressurized Expansion Tank	Bell & Gossett	D-40V	21.7 gal	16"	30"	271.00 lbm	

Air Separator Schedule

Mark	Location	Type	Manufacturer	Model	Inlet Size	Tank Height	Tank Diameter	GPM	Unit Operating Weight (LBS)	Notes
AS-1	Mezzanine	Air Separator With Strainer	Bell & Gossett	R-2N	0' - 2"	1' - 3 7/8"	0' - 7 3/8"	140 GPM	66	1

Notes:
1. Provide with removable strainer.

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REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

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CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature
Travis L. Willemssen
Name
47945 License #
July 25, 2019 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: JJN
CHECKED BY: TLW

SHEET NAME:
MECHANICAL SCHEDULES

SHEET NO:
M6.0

ELECTRICAL ABBREVIATIONS

A	AMPERE	KVA	KILOVOLT-AMPERE
AB	ABOVE BACKSPLASH	KW	KILOWATT
AC	ALTERNATING CURRENT	LOC	LOCATION
ADD	ADDENDUM	LTG	LIGHTING
AFF	ABOVE FINISHED FLOOR	LV	LOW-VOTAGE
AFG	ABOVE FINISHED GRADE	MAX	MAXIMUM
AHU	AIR HANDLING UNIT	MCC	MOTOR CONTROL CENTER
ARCH	ARCHITECTUAL	MDF	MAIN DISTRIBUTION FRAME
ATS	AUTOMATIC TRANSFER SWITCH	MECH	MECHANICAL
AUTO	AUTOMATIC	MIN	MINIMUM
BCCT	BOTTOM OF CABLE TRAY	MFGR	MANUFACTURER
C	CONDUIT	MSS	MOTOR STARTER SWITCH
CB	CIRCUIT BREAKER	MTC	EMPTY CONDUIT
CCT,CKT	CIRCUIT	MTD	MOUNTED
CCTV	CLOSED CIRCUIT CONNECTION	MTS	MANUAL TRANSFER SWITCH
CLG	CEILING	NA	NOT APPLICABLE
COMB	COMBINATION	NC	NORMALLY CLOSED
CONN	CONNECT, CONNECTION	NO	NORMALL OPEN
CONTR	CONTRACTOR	NF	NON-FUSED
CUH	CABINET UNIT HEATER	OC	ON CENTER
DIST	DISTRIBUTION	OS	OCCUPANCY CENTER
DN	DOWN	PB	PULL-BOX
DWG	DRAWING	PE	PNEUMATIC-ELECTIC SWITCH
EA	EACH	PH	PHASE
EC	ELECTRICAL CONTRACTOR	PNL	PANEL
ELR	END-OF-LINE RESISTOR	PR	PAIR
EM	EMERGENCY	PVC	POLY-VINYL-CHLORIDE
EMS	ENERGY MANAGEMENT SYSTEM	PWR	POWER
EP	ELECTRICAL PNEUMATIC SWITCH	REC	RECEPTACLE
EQUIP	EQUIPMENT	RM	ROOM
EX	EXISTING	S	DENOTES "SURFACE" DEVICE
EXPL	EXPLOSION PROOF	SHT	SHEET
FA	FIRE ALARM	SPC	SPACE
FDR	FEEDER	SPR	SPARE
FIN	FINISHED	SS	STAINLESS STEEL
FLR	FLOOR	SW	SWITCH
FLA	FULL LOAD AMPS	SWBD	SWITCHBOARD
FSEC	FOOD SERVICE EQUIPMENT CONTRACTOR	SWGR	SWITCHGEAR
FACP	FIRE ALARM CONTROL PANEL	TC,TS	TIME-CLOCK, TIME-SWITCH
GND,GRD	GROUND	TELE	TELEPHONE
GFI,GFCI	GROUND-FAULT CIRCUIT INTERRUPTER	TERM	TERMINAL
HOA	HAND-OFF-AUTOMATIC ALARM	TSFR	TRANSFER
HP	HORSEPOWER	TV	TELEVISION
HTG	HEATING	TYP	TYPICAL
HTR	HEATER	TVSS	TRANSIENT VOLTAGE SURGE PROTECTION
HUH	HORIZONTAL UNIT HEATER	UG	UNDERGROUND
HZ	HERTZ	UH	UNIT HEATER
I/L	INTERLOCK	UV	UNIT VENTILATOR
I/C	INTERCOM	V	VOLTAGE
IDF	INTERMEDIATE DISTRIBUTION FRAME	VA	VOLT-AMPERE
IC	INTERRUPTING CAPACITY	VFD	VARIABLE FREQUENCY DRIVE
IG	ISOLATED GROUND	W	WATTAGE
JB	JUNCTION BOX	WM	SURFACE WIREMOLD
		WP	WEATHER PROOF

Elec Sheet Index

Branch Circuit Sizing (120V, 20A circuits)	
Circuit Length(ft)	Wire Size*
0 - 75'	#12 AWG
76' - 150'	#10 AWG
151' - 240'	#8 AWG
241' - 380'	#6 AWG

* Wire size applies to both the hot and neutral conductor. Provide an Equipment ground sized to comply with T250.122 of the NEC.

ELECTRICAL SYMBOLS

SYMBOL	DESCRIPTION	HEIGHT/ NOTE	SYMBOL	DESCRIPTION	HEIGHT/ NOTE
	LIGHT FIXTURE TYPE DESIGNATION CIRCUIT NUMBER SWITCH REFERENCE (R# = RELAY CONTROL) HATCHED INDICATES AN EMERGENCY LIGHT NL (NL=NIGHT LIGHT)		(#)	ELECTRICAL KEY NOTE SYMBOL NUMBER	
			EF-1	MOTOR OR EQUIPMENT; SEE SCHEDULES	
			2/E1	VIEW REFERENCE; REFER TO INDICATED SECTION OR DETAIL	
	RECESSED DOWNLIGHT		J	JUNCTION BOX	18"
	PENDANT - COORDINATE LENGTH WITH ARCHITECT		AV	A/V CONNECTION ROUGH-IN	24" NOTE 1
	WALL-MOUNTED FIXTURE EXTERIOR DEFAULT MOUNTING HEIGHT = 12'		SB	SMARTBOARD CONNECTION ROUGH-IN	24" NOTE 9
	TRACK LIGHTING- INDICATES NUMBER OF LIGHTS		TV	TV CONNECTION ROUGH-IN: SINGLE-GANG JUNCTION BOX W/ (1) DATA DROP TERMINATED IN BISCUIT BOX	60"
	EXIT LIGHT-WITH DIRECTIONAL ARROW(S); DARKENED AREA INDICATES NUMBER AND ORIENTATION OF FACES		C	CLOCK	80"
	EXIT LIGHT-WITH EMERGENCY LIGHTING HEADS AND DIRECTIONAL ARROWS		C	CLOCK W/ TWO FACES; END-MOUNT	80"
	EMERGENCY LIGHTING WALL PACK		S S	SPEAKER; WALL OR CEILING MOUNTED "V" ANNOTATION INDICATES SPEAKER WITH VOLUME CONTROL	80"/CLG
	EMERGENCY LIGHTING REMOTE HEAD		S	LOCAL SOUND SYSTEM SPEAKER	
	STANDARD SNAP LIGHT SWITCH	46"	S J	SPEAKER JACK	
LD#	LOW-VOLTAGE SWITCH; "LD#" INDICATES A SPECIFIC LOW-VOLTAGE LIGHTING DETAIL	46" NOTE 10	S	PROJECTION SPEAKER "WP" ANNOTATION INDICATES WEATHERPROOF EXTERIOR SPEAKER	80"
D	DIMMER SWITCH	46"	M M	MICROPHONE; WALL OR CEILING MOUNTED	18"/CLG
3	THREE-WAY SWITCH	46"	A	AUDIO JACK	
4	FOUR-WAY SWITCH	46"	V	VOLUME CONTROL	46"
K	KEY-OPERATED SWITCH	46"	B	BELL OR OTHER AUDIBLE DEVICE	80"
O	SWITCH WITH PILOT LIGHT	46"			
OS	ON/OFF SWITCH WITH OCCUPANCY SENSOR	46"		DATA OUTLET; STANDARD (1) DATA DROP "W" ANNOTATION DENOTES MOUNTING HEIGHT AT 46"	18" NOTE 7
OS##	OCCUPANCY SENSOR: D1 - CEILING MT, 500SF DUAL TECH, STANDALONE W/ POWER PACK D2 - CEILING MT, 2000SF DUAL TECH, STANDALONE W/ POWER PACK L1 - CEILING MT, 2000SF DUAL TECH, CONNECTED TO LTG CTRL PANEL W1 - WALL MT AT SWITCH LOCATION, 1-BUTTON FOR ON/OFF W2 - WALL MT AT SWITCH LOCATION, 2-BUTTON FOR LEVEL CONTROL N1 - CEILING SENSOR CONNECTED TO ROOM CONTROLLER PER DETAIL N2 - CEILING SENSOR CONNECTED TO ROOM CONTROLLER PER DETAIL N3 - WALL MT, GYMNASIUM W/ W/REGUARD			DATA OUTLET; STANDARD (2) DATA DROPS "-D" ANNOTATION DENOTES NONTYPICAL DROP QTY, EG "3D"	24" NOTE 7
			WAP	WIRELESS ACCESS POINT; STANDARD (2) DATA DROPS	CLG NOTE 12
				DATA OUTLET; STANDARD (3) DATA DROPS	24" NOTE 7
				PANELBOARD	NOTE 5
DS	DAYLIGHT SENSOR (TO ROOM CONTROLLER)	NOTE 11		ELECTRICAL SWITCHBOARD OR SPECIALTY EQUIPMENT; SEE LABELLING OR KEYED NOTE ON SHEET	
TS	TIME-SWITCH (TC: TIME-CLOCK)		C	CAMERA ROUGH-IN; PROVIDE (1) DATA DROP	
PC	PHOTOCELL		CR	CARD READER ROUGH-IN	42"
	COMBINATION USB/DUPLEX RECEPTACLE	24"	DB	DOOR BELL	42"
	RECEPTACLE (DUPLEX)	24"	EL	ELECTRIC LOCK/STRIKE	
	QUADRUPLEX RECEPTACLE	24"	REX	REQUEST TO EXIT	
	GFI RECEPTACLE (DUPLEX)	46" NOTE 1	DC	DOOR CONTACT	
	DUPLEX RECEPTACLE ON EMERGENCY POWER	24"		SAFETY SWITCH	60"
	QUADRUPLEX RECEPTACLE ON EMERGENCY POWER	24"		MOTOR STARTER	60"
G	GREEN DUPLEX RECEPTACLE ON OCCUPANCY SENSOR REFER TO LOW VOLTAGE DETAILS	24"		COMBINATION MOTOR STARTER/SAFETY SWITCH	60"
G	GREEN QUADRUPLEX RECEPTACLE ON OCCUPANCY SENSOR REFER TO LOW VOLTAGE DETAILS	24"	T	THERMOSTAT	46"
TR	DUPLEX RECEPTACLE (TAMPER RESISTANT)	24"	R	RELAY	60"
	DUPLEX RECEPTACLE (SPLIT WIRED)	24"	S	ELECTRICALLY OPERATED SOLENOID	
	SPECIAL PURPOSE OUTLET	18"		GROUND	
	POKE-THRU FLOORBOX; ATTACHED SYMBOLS INDICATE INSTALLED DEVICES/SERVICES			CONDUIT STUB	
	IN-GRADE FLOORBOX; ATTACHED SYMBOLS INDICATE INSTALLED DEVICES/SERVICES			INDICATES DEVICES SHOWN UNDER COMMON COVERPLATE	
EC	ACTIVATION KIT IN FLOORBOX. PROVIDE 1-1/2" CONDUIT TO ACCESSIBLE CEILING SPACE FOR FUTURE A/V INSTALL BY OWNER.		N	NURSE CALL - PATIENT (CB, SA, AND PILLOW SPEAKER)	
F	FIRE ALARM MANUAL PULL STATION		N D	NURSE CALL - DUTY STATION	
F	FIRE ALARM SPEAKER	NOTE 6	N CB	NURSE CALL - CODE BLUE	
F	FIRE ALARM STROBE	NOTE 6	N SA	NURSE CALL - STAFF ASSIST	
E	EMERGENCY STROBE	NOTE 6	N DL	NURSE CALL - DOME LIGHT	
F	FIRE ALARM SPEAKER/STROBE	NOTE 6	N T	NURSE CALL - TOILET PULL	
F S	FIRE ALARM SMOKE DETECTOR				
F H	FIRE ALARM HEAT DETECTOR			HOME RUN	
F DS	FIRE ALARM DUCT SMOKE DETECTOR				
F R	REMOTE DUCT SMOKE DETECTOR TEST STATION			INDICATES GROUND WIRE (HOOK ISOLATED GRD; DOT-SAFETY GRD.) LP1 PANELBOARD 1,3,5 CIRCUIT NUMBERS #8 ANY CIRCUIT WITHOUT DESIGNATION IS A TWO WIRE CIRCUIT. ANY GREATER NUMBER OF WIRES IS INDICATED BY CROSS MARKS. LONG CROSSMARK IS NEUTRAL(GROUNDED) DENOTES WIRE SIZE OTHER THAN #12 AWG	
FS	FIRE SMOKE DAMPER	NOTE 8			
SD	SMOKE DAMPER	NOTE 8			
F FS	FIRE ALARM FLOW-SWITCH				
F TS	FIRE ALARM TAMPER SWITCH				
F SV	FIRE ALARM SOLENOID VALVE			FEEDER TAG	
F DH	FIRE ALARM DOOR HOLD OPEN (MAGNETIC)			<100A3G> 100A 3 G AMPERAGE # OF CONDUCTORS G = GROUND REQUIRED	
F AM	FIRE ALARM INDIVIDUAL ADDRESSABLE MODULE				
F K	FIREMANS KEY LOCK BOX	46"			
FACP	FIRE ALARM CONTROL PANEL				
FAAM	FIRE ALARM ANNUNCIATOR PANEL AND MICROPHONE UNIT				

ELECTRICAL SYMBOL NOTES

1. EQUIPMENT SHALL BE INSTALLED AT THE MOUNTING HEIGHTS INDICATED UNLESS SHOWN OTHERWISE ON THE ARCH. ELEVATIONS, NOTED ON THE DRAWINGS, OR IN THE SPECIFICATIONS.
2. ALL MOUNTING HEIGHTS ARE TO CENTER OF DEVICE FROM FINISHED FLOOR. MOUNTING HEIGHTS INDICATED ON WALL ELEVATIONS, TAKE PRECEDENCE OVER MOUNTING HEIGHTS LISTED ABOVE.
3. LETTERS ADJACENT TO SYMBOLS INDICATE UNIT TYPE - SEE SPECS.
4. DOTTED SYMBOLS INDICATE EXISTING DEVICES.
5. MOUNT TOP OF PANEL AT 6.0' A.F.F.
6. MOUNT AT 80" OR 6.0" BELOW CEILING-WHICHEVER IS LOWEST.
7. PROVIDE DEVICES INDICATED AND A 2-GANG DEEP BOX WITH ONE (1) 3/4" CONDUIT TO ACCESSIBLE CEILING SPACE OR NEAREST DATA CLOSET OR AS INDICATED ON THE DRAWINGS.
8. PROVIDE 120V CONNECTION TO THE FIRE SMOKE / SMOKE DAMPER. PROVIDE A DUCT SMOKE DETECTOR WITH CONNECTIONS TO DAMPER & FACP. PROVIDE INTEGRATION WITH SERVING UNIT. DAMPER SHALL CLOSE WHENEVER SERVING UNIT IS NOT RUNNING.
9. PROVIDE A 1900 DEEP JUNCTION BOX WITH (2) 1" EMPTY CONDUITS TO THE CEILING SPACE ABOVE. PROVIDE A 2 GANG MUD RING WITHOUT ANGLED CORNERS FOR THE FUTURE SMARTBOARD OR AV SYSTEM.
10. LOW VOLTAGE SWITCH. "LD#" INDICATES CONTROL TYPE. REFER TO CORRESPONDING DETAIL FOR REQUIRED DEVICES AND CONNECTIONS FOR LIGHTING, SENSOR AND RECEPTACLE CONTROL.
11. DAYLIGHT SENSOR CONNECTED TO ROOM CONTROLLER FOR DIMMED DAYLIGHT CONTROL. REFER TO DAYLIGHTING CONNECTION DETAIL.
12. PROVIDE WIRELESS ACCESS POINT AND JACK TERMINATED IN A BISCUIT BOX LOCATED ABOVE THE CEILING. EACH LOCATION SHALL HAVE (2) CAT 6 JACKS.
13. PROVIDE 5" SQUARE DEEP JUNCTION BOX.

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REVISIONS / ISSUE

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PROJECT NAME:

CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG

6246 190th St. E.
Prior Lake, MN 55372

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Signature

Daniel S. Paulson
Name

23796 License #

July 25, 2019 Date

PROJECT NUMBER: 18-42

DATE OF ISSUE: July 25, 2019

DRAWN BY: RTA

CHECKED BY: DSP

SHEET NAME:

ELECTRICAL TITLE SHEET

SHEET NO:

E0.0

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1 ELECTRICAL SITE PLAN
1" = 240'

2 ELECTRICAL SITE PLAN DEMO
1" = 40'-0"

Alternate Description:

Provide conduit stubbed 5' beyond new pad from exterior switchgear as base bid. Provide new underground feeders to out buildings as part of Alternate bid as indicated in Note 18. Remove existing overhead service as part of Alternate bid as indicated by Note 4.

	Electrical Keyed Notes
1	New pad mount transformer by utility. Provide pad per utility requirements.
2	New underground primary feeder by utility.
3	Existing overhead service to be removed.
4	Existing overhead service to be removed upon acceptance of Alternate 1 and after new services have been installed and are operational.
5	Existing feeders to fuel pumps to be disconnected and removed. Reconnect as shown on new electrical plans.
6	Coordinate with district's vendor to pull back existing fiber to hand hole during construction. Reconnect as shown on new electrical plans.
7	Existing well to be disconnected and replaced with new.
8	Existing communication lines to fuel pumps to be disconnected and removed. Reconnect as shown on new electrical plans.
9	Existing fiber hand hole.
10	Existing communication lines to be abandoned.
11	Existing utility pole and underground service to be disconnected and removed.
12	Intercept existing conduit. Reconnect as shown on new electrical plans.
13	Provide hand hole and 2" conduit to IT Room.
14	Provide 2" conduit from existing hand hole to IT Room.
15	Provide 1" conduit from fuel island to wireway, with seal offs at each end, then through contactor and to Panel LP-1, circuits 1/3.
16	Provide new light pole and circuit to wireway, with seal offs at each end, then through contactor and to Panel LP-1, circuit 5. Refer to 3/E4.0 for light pole base details.
17	New utility transformer and exterior switchgear.
18	Provide new undergroud feeder up to building with Type LB connector as a part of Alternate 1. Contractor to patch hole. Refer to Electrical Riser 5/E4.0 for details.
19	Feed new well pump from new building electrical service. Refer to Building Equipment Schedule for details.

3 ELECTRICAL SITE PLAN NEW
1" = 40'-0"

NORTH

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Name

23796 License #
July 25, 2019 Date

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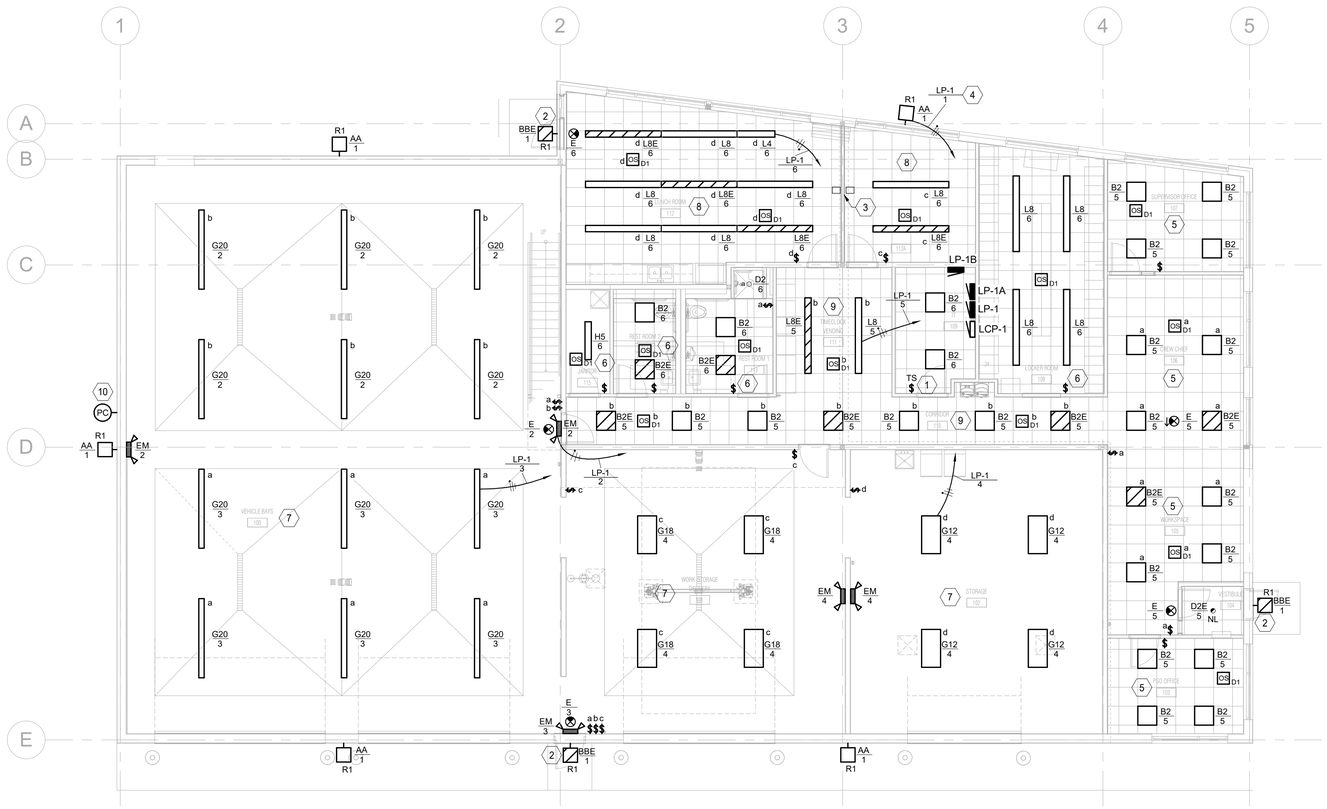
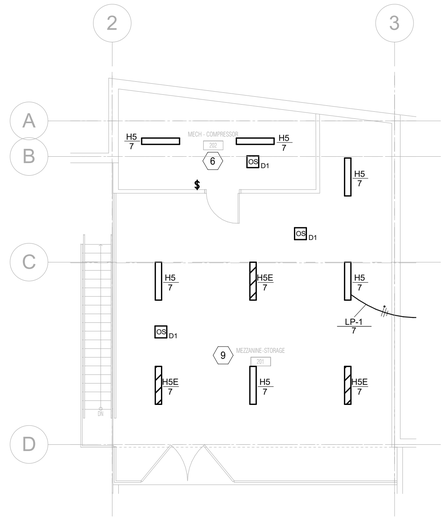
SHEET NAME:
ELECTRICAL SITE PLAN

SHEET NO:
E0.1



1 MAIN LEVEL - LIGHTING PLAN
1/8" = 1'-0"



2 MEZZANINE - LIGHTING PLAN
1/8" = 1'-0"

General Notes - Lighting	
A	Conduit and wire connections are not shown. Provide conduit and wire as required for the indicated circuitry.
B	A maximum of three circuits may be installed in a conduit. Unless noted otherwise, multi-wire circuits are not permitted for new branch circuits.
C	Do not install any electrical equipment to interfere with servicing HVAC equipment.
D	For exact location of ceiling mounted electrical lighting, devices, equipment, etc., refer to architectural reflected ceiling plans (rcp); for wall mounted devices, see architectural elevations.
E	Light fixtures with hatching indicate that the fixture is to be provided with an emergency battery driver. Provide an unswitched phase conductor to fixture to monitor for loss of power.
F	Where dimming switches are shown, provide a 0-10V dimmer compatible with the fixture(s) being controlled. Provide On/Off and Raise/Lower buttons.

	Electrical Keyed Notes
1	Provide a time switch at this location for local lighting control.
2	Provide connection to remote emergency battery pack. Battery pack to be installed indoors. Provide connection between battery and exterior light fixture as required.
3	Provide partition sensor to allow lighting to be controlled together when partition is open and separately when partition is closed.
4	Route circuit though Lighting Control Panel prior to termination in panel.
5	Refer to Detail 1/E4.0 for lighting control requirements in this room.
6	Refer to Detail 2/E4.0 for lighting control requirements in this room.
7	Refer to Detail 3/E4.0 for lighting control requirements in this room.
8	Refer to Detail 4/E4.0 for lighting control requirements in this room.
9	Lighting in this area to be controlled by occupancy sensors with automatic on to 100% and automatic off after owner defined time period.
10	Provide an exterior photcell wired as an input to LCP-1.

NORTH

ThreeRivers PARK DISTRICT
in partnership with
Scott County

CONSULTANT:
ARTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

Paulson & Clark Engineering
Structural | Mechanical | Electrical | Security

REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

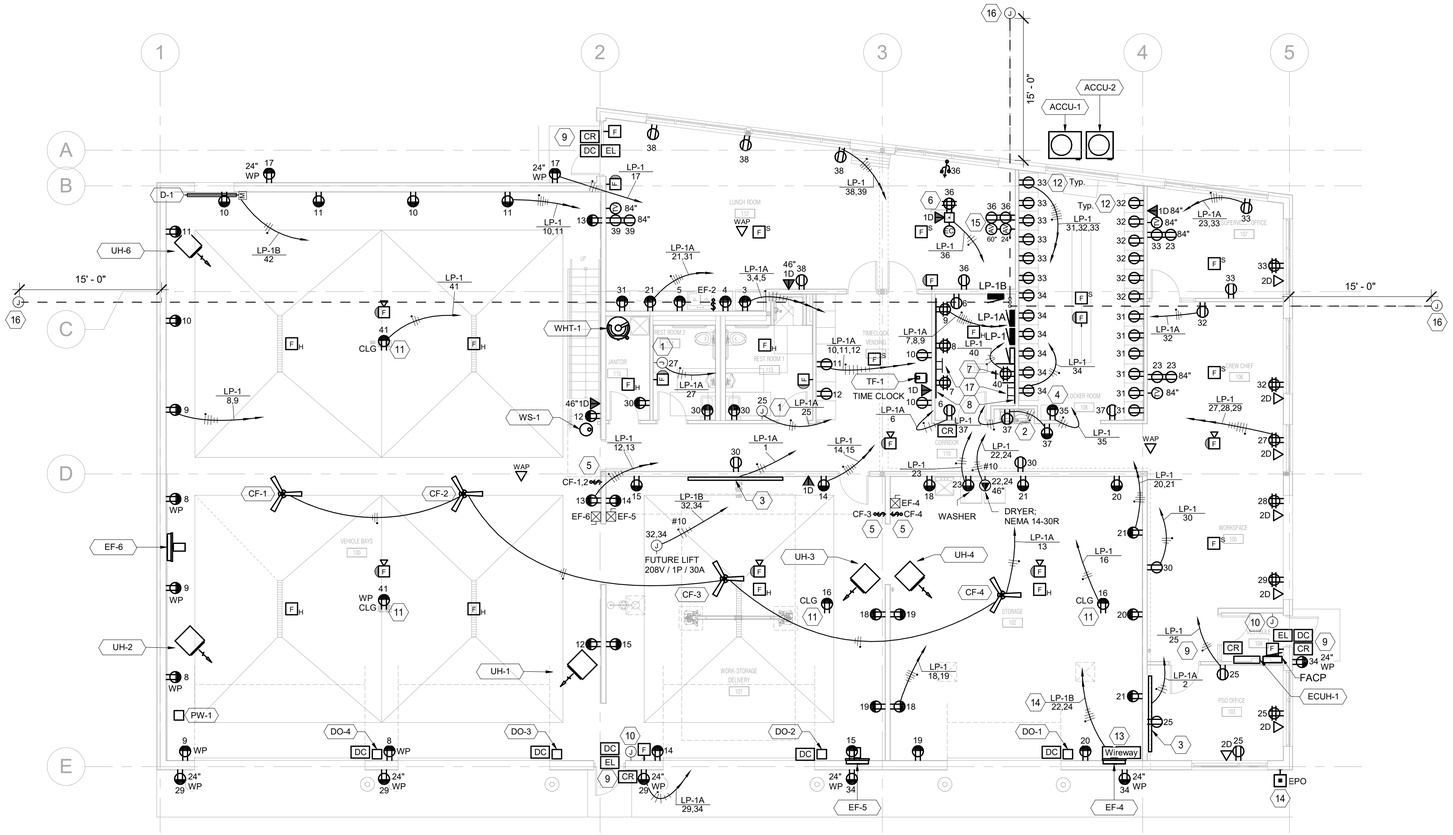
Signature
Daniel S. Paulson
Name
23796 License #
July 25, 2019 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RTA
CHECKED BY: DSP

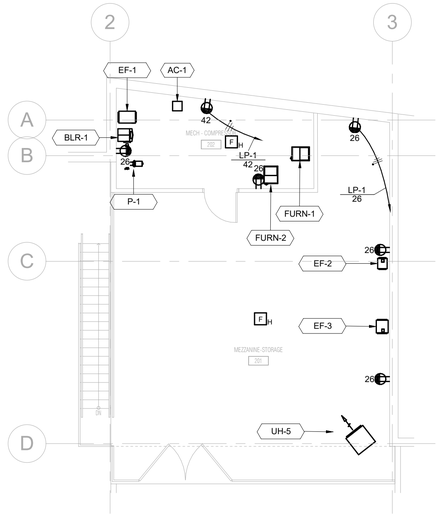
SHEET NAME:
LIGHTING PLAN

SHEET NO:
E1.0

PLOTTED: 7/24/2019 4:34:39 PM FILE NAME: D:\Projects\Cleary Lake r19_twillemssen.rvt



1 MAIN LEVEL - POWER & SYSTEMS PLAN
1/8" = 1'-0"



2 MEZZANINE - POWER & SYSTEMS PLAN
1/8" = 1'-0"

NORTH

General Notes - Power & Systems	
A	Conduit and wire connections are not shown. Provide conduit and wire as required for the indicated circuitry.
B	A maximum of three circuits may be installed in a conduit. Unless noted otherwise, multi-wire circuits are not permitted for new branch circuits. Every 120V and 277V single phase circuit shall be provided with a dedicated neutral.
C	Do not install any electrical equipment to interfere with servicing HVAC equipment.
D	Verify exact locations of all mechanical equipment with Mechanical Contractor prior to rough-in.
E	Verify exact locations of all owner provided building equipment with the Owner prior to rough-in.
F	Verify exact locations and NEMA configurations of plugs of all owner provided building equipment with the owner prior to rough-in.
G	For all voice/data devices shown, provide a double gang, deep, junction box with a 1" conduit routed to accessible ceiling space or routed underground to IT closet.
H	For secuity devices indicated, provide rough-in only.
I	Wiring is not shown for fire alarm system. Provide conduit and all necessary wiring for a complete and operating system.
J	All electrical and fire alarm devices shall be flush mounted in sheet rock, brick or block walls unless noted otherwise.

	Electrical Keyed Notes
1	Provide a surface mounted EXCEL DRYER #TA-ABS-SB-120V hand dryer with dedicated GFI circuit. Refer to architectural elevations for mounting height.
2	Provide receptacle mounted within electric water cooler enclosure. Receptacle shall be fed from an accessible GFCI device. No exposed cords will be acceptable.
3	Provide plug strip mounted at 48" for chargers.
4	Provide receptacle with dedicated circuit for cord and plug connection to boot/glove dryer (by owner).
5	Adjustable motor speed controller for ceiling fans.
6	Provide an Evolution EFB6 series, or pre-approved equal, floor box recessed flush with floor. Populate box with devices shown. Provide 1-1/2" conduit routed under the floor to nearest wall and to the AV boxes. Provide (2) 1" conduit routed to nearest wall and to accessible ceiling space for data cabling. Provide (2) duplex outlets within floor box.
7	Provide a 2" conduit to fiber handhole and coordinate with district's vendor to reinstall existing fiber.
8	Provide 8' tall, 3/4". A/C grade plywood in a 4' sections. Paint with a light colored fire retardant paint prior to the installation of any equipment.
9	Provide Rough-in for card reader. Refer to detail 4/E4.0 for requirements.
10	Provide a double-gang J-box with 3/4" empty conduit to nearest accessible ceiling space for security key pad. Key pad and cabling by owner.
11	Provide receptacle at ceiling for future cord reels (by owner). Verify location with owner prior to rough-in.
12	Provide receptacle mounted 6" above each locker (typical). Grommet provided by others.
13	Fuel island wireway with sealoffs.
14	Provide contactor, EPO switch, wireway, and sealoffs as required. Provide connection to existing fuel pumps, pole mounted light fixture, monitoring equipment, etc. as required for a complete and proper installation. Connect such that EPO switch shuts down and restarts all equipment.
15	Provide 1-1/2" conduit from floor box, between AV boxes, and routed up to accessible ceiling space.
16	Provide a 2" empty conduit stubbed to a UL listed,Tier 15, electric handhole. HUBBLE QUAZITE #PC1212BA12 series with bolt on cover with "ELECTRIC" stamped into cover (#PC1212CA0017). Locate handholes 15' from edge of building. Typical of 3 locations.
17	Provide ground bar with standoffs. Refer to detail 7/E4.0.

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Daniel S. Paulson
Signature
Daniel S. Paulson
Name
23796 July 25, 2019
License # Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RTA
CHECKED BY: DSP

SHEET NAME:
POWER & SYSTEMS PLAN

SHEET NO:
E2.0

PLOTTED: 7/24/2019 4:34:42 PM FILE NAME: D:\Projects\Cleary Lake r19_twillemssen.rvt

Branch Panel: LP-1

Location: ELEC/IT 109 | **Supply From:** Utility | **Mounting:** Surface | **Enclosure:** NEMA 1
Volts: 120/208 Wye | **Phases:** 3 | **Wires:** 4 | **Feed-Thru Lugs:** Yes
A.I.C. Rating: 22 kA | **Mains Type:** MCB | **Mains Rating:** 400 A | **Bussing:** 400 A Cu

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Lighting: Building Exterior	20 A	1	265 VA	974 VA					1	20 A	Lighting: Vehicle Bay 100	2
3	Lighting: Vehicle Bay 100	20 A	1			972 VA	776 VA			1	20 A	Lighting: Rooms 101,102	4
5	Lighting: Rooms 103-107,110,111	20 A	1					655 VA	788 VA	1	20 A	Lighting: Rooms 108,109,112-115	6
7	Lighting: Mezzanine Storage 201	20 A	1	378 VA	540 VA					1	20 A	Receptacles: Vehicle Bays 100	8
9	Receptacles: Vehicle Bays 100	20 A	1			540 VA	540 VA			1	20 A	Receptacles: Vehicle Bays 100	10
11	Receptacles: Vehicle Bays 100	20 A	1					540 VA	360 VA	1	20 A	Receptacles: Vehicle Bays 100	12
13	Receptacles: Vehicle Bays 100	20 A	1	360 VA	540 VA					1	20 A	Receptacles: Work-Storage 101	14
15	Receptacles: Work-Storage 101	20 A	1			540 VA	360 VA			1	20 A	Cord Reels: Rooms 101,102	16
17	Receptacles: Patio	20 A	1					360 VA	540 VA	1	20 A	Receptacles: Storage 102	18
19	Receptacles: Storage 101,102	20 A	1	540 VA	540 VA					1	20 A	Receptacles: Storage 102	20
21	Receptacles: Storage 102	20 A	1			540 VA	2000...			2	30 A	GFI Receptacle: Storage 102...	22
23	Receptacle: Storage 102 (Washer)	20 A	1					1200...	2000...	--	--	--	24
25	Receptacles: PSO Office 103	20 A	1	900 VA	900 VA					1	20 A	Receptacles: Mezzanine 201, 202	26
27	Receptacle: Workspace 105	20 A	1			360 VA	360 VA			1	20 A	Receptacle: Workspace 105	28
29	Receptacle: Workspace 105	20 A	1					360 VA	1080...	1	20 A	Receptacles: General	30
31	Receptacles: Locker Room 108	20 A	1	1080...	1080...					1	20 A	Receptacles: Locker Room 108	32
33	Receptacles: Locker Room 108	20 A	1			1080...	1080...			1	20 A	Receptacles: Locker Room 108	34
35	Rec: Locker Room 108 (Boot Dryer)	20 A	1					180 VA	900 VA	1	20 A	Receptacles: Conference Room...	36
37	Receptacles: EWC/General	20 A	1	540 VA	720 VA					1	20 A	Receptacles: Lunch Room 112	38
39	Receptacles: Lunch Room 112 (TV)	20 A	1			360 VA	360 VA			1	20 A	Receptacle: IT 109 (Fiber Cabinet)	40
41	Cord Reels: Vehicle Bay 100	20 A	1					360 VA	180 VA	1	20 A	Receptacle: Mech Comp (Air Dryer)	42
			Total Load:	35290 VA		37492 VA		29432 VA					
			Total Amps:	302 A		320 A		245 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Cooling	16630 VA	100.00%	16630 VA		
Electric Heat	5000 VA	125.00%	6251 VA	**Total Conn. Load:**	102093 VA
HVAC	5999 VA	125.00%	7499 VA	**Total Est. Demand:**	94311 VA
Heating	2598 VA	100.00%	2598 VA	**Total Conn. Current:**	283 A
Lighting	5758 VA	125.00%	7198 VA	**Total Est. Demand...**	262 A
Motor	31741 VA	100.00%	31741 VA		
Other	3346 VA	100.00%	3346 VA		
Power	100 VA	125.00%	125 VA		
Receptacle	34140 VA	64.65%	22070 VA		

Notes:

Branch Panel: LP-1A

Location: ELEC/IT 109 | **Supply From:** LP-1 | **Mounting:** Surface | **Enclosure:** NEMA 1
Volts: 120/208 Wye | **Phases:** 3 | **Wires:** 4 | **Feed-Thru Lugs:** Yes
A.I.C. Rating: 22 kA | **Mains Type:** MLO | **Mains Rating:** 400 A | **Bussing:** 400 A Cu

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	Plug Strip: Work-Storage 101	20 A	1	924 VA	924 VA					1	20 A	Plug Strip: POS Office 103	2
3	Receptacle: Lunch Room 112	20 A	1			1000...	1000...			1	20 A	Receptacle: Lunch Room 112	4
5	Receptacle: Lunch Room 112	20 A	1					1000...	360 VA	1	20 A	Receptacles: Mech/IT 109	6
7	Receptacles: Mech/IT 109	20 A	1	360 VA	360 VA					1	20 A	Receptacles: Mech/IT 109	8
9	Receptacles: Mech/IT 109	20 A	1			360 VA	360 VA			1	20 A	Receptacles: Timeclock 111	10
11	Rec: Vending 111 (GFI Breaker)	20 A	1					180 VA	180 VA	1	20 A	Rec: Vending 111 (GFI Breaker)	12
13	Ceiling Fans	20 A	1	480 VA	4576...					2	70 A	AC-1	14
15	PW-1	50 A	3			2906...	4576...			--	--	--	16
17	--	--	--					2906...	149 VA	1	20 A	TF-1	18
19	--	--	--	2906...	745 VA					3	20 A	DO-1, DO-2	20
21	Receptacle: Lunch Room 112	20 A	1			1000...	745 VA			--	--	--	22
23	Receptacles: Room 106/07 (TV)	20 A	1					540 VA	745 VA	--	--	--	24
25	Hand Dryer (GFI Breaker)	20 A	1	950 VA	745 VA					3	20 A	DO-3, DO-4	26
27	Hand Dryer (GFI Breaker)	20 A	1			950 VA	745 VA			--	--	--	28
29	Receptacles: Exterior	20 A	1					540 VA	745 VA	--	--	--	30
31	Receptacle: Lunch Room 112	20 A	1	1000...	540 VA					1	20 A	Receptacles: Crew Chief 106	32
33	Receptacles: Supervisor Office 107	20 A	1			900 VA	540 VA			1	20 A	Receptacles: Exterior	34
35	P-1	20 A	3					480 VA	0 VA	1	20 A	Spare	36
37	--	--	--	480 VA	0 VA					1	20 A	Spare	38
39	--	--	--			480 VA	0 VA			1	20 A	Spare	40
41	WS-1	20 A	1					500 VA	0 VA	1	20 A	Spare	42
			Total Load:	26032 VA		27727 VA		20066 VA					
			Total Amps:	225 A		239 A		167 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Cooling	16630 VA	100.00%	16630 VA		
Electric Heat	5000 VA	125.00%	6251 VA	**Total Conn. Load:**	73697 VA
HVAC	5999 VA	125.00%	7499 VA	**Total Est. Demand:**	76570 VA
Heating	2598 VA	100.00%	2598 VA	**Total Conn. Current:**	205 A
Lighting	950 VA	125.00%	1188 VA	**Total Est. Demand...**	213 A
Motor	31741 VA	100.00%	31741 VA		
Other	3346 VA	100.00%	3346 VA		
Power	100 VA	125.00%	125 VA		
Receptacle	10220 VA	98.92%	10110 VA		

Notes:

Branch Panel: LP-1B

Location: ELEC/IT 109 | **Supply From:** LP-1A | **Mounting:** Surface | **Enclosure:** NEMA 1
Volts: 120/208 Wye | **Phases:** 3 | **Wires:** 4 | **Feed-Thru Lugs:** Yes
A.I.C. Rating: 22 kA | **Mains Type:** MLO | **Mains Rating:** 400 A | **Bussing:** 400 A Cu

CKT	Circuit Description	Trip	Poles	A		B		C		Poles	Trip	Circuit Description	CKT
1	BLR-1	20 A	1	396 VA	667 VA					1	20 A	UH-1	2
3	FURN-1	20 A	1			1536...	667 VA			1	20 A	UH-2	4
5	FURN-2	15 A	1					1212...	137 VA	1	20 A	UH-3, UH-4, UH-5	6
7	EF-1	20 A	1	312 VA	1127...					1	20 A	UH-6	8
9	EF-2	20 A	1			312 VA	1664...			2	20 A	WP-1	10
11	EF-3	30 A	1					1356...	1664...	--	--	--	12
13	EF-4	20 A	3	480 VA	1667...					3	20 A	ECUH-1	14
15	--	--	--			480 VA	1667...			--	--	--	16
17	--	--	--					480 VA	1667...	--	--	--	18
19	EF-5	20 A	3	480 VA	950 VA					1	20 A	Fuel Island; Light Pole	20
21	--	--	--			480 VA	500 VA			1	20 A	Fuel Island; Pedestal	22
23	--	--	--					480 VA	500 VA	1	20 A	Fuel Island; Fuel Pumps	24
25	EF-6	20 A	3	480 VA	100 VA					1	20 A	Fuel Island; EPO Switch	26
27	--	--	--			480 VA	60 VA			1	20 A	FACP	28
29	--	--	--					480 VA	500 VA	1	20 A	WHT-1	30
31	ACCU-1 (HACR)	35 A	3	2152...	1373...					2	30 A	Future Lift	32
33	--	--	--			2152...	1373...			--	--	--	34
35	--	--	--					2152...	60 VA	1	20 A	LCP-1	36
37	ACCU-2 (HACR)	30 A	3	1950...	0 VA					2	20 A	Spare	38
39	--	--	--			1950...	0 VA			--	--	--	40
41	--	--	--					1950...	50 VA	1	20 A	Motorized Damper	42
			Total Load:	11541 VA		12658 VA		12043 VA					
			Total Amps:	96 A		106 A		101 A					

Load Classification	Connected Load	Demand Factor	Estimated Demand	Panel Totals	
Cooling	16630 VA	100.00%	16630 VA		
Electric Heat	5000 VA	125.00%	6251 VA	**Total Conn. Load:**	36125 VA
HVAC	4492 VA	125.00%	5615 VA	**Total Est. Demand:**	38660 VA
Heating	2598 VA	100.00%	2598 VA	**Total Conn. Current:**	100 A
Lighting	950 VA	125.00%	1188 VA	**Total Est. Demand...**	107 A
Motor	7075 VA	100.00%	7075 VA		
Other	946 VA	100.00%	946 VA		
Power	100 VA	125.00%	125 VA		

Notes:

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23796 License #
July 25, 2019 Date

PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RTA
CHECKED BY: DSP

SHEET NAME:
ELECTRICAL PANELBOARD SCHEDULES

SHEET NO:
E3.0

Building Equipment Schedule												
Mark	Description	Size	Voltage	Phase	Disc. By	Disc. Size	Disc. Poles	Disc. Fuses	Disc. Location	Panel	Circuit Number	Feeder
AC-1	Air Compressor	7-1/2 HP	208 V	1	EC	60 A	2	60 A	Near Unit	LP-1A	14,16	<60A2G>
DO-1	Overhead Door Operator	3/4 HP	208 V	3	EC	30 A	3	10 A	Near Unit	LP-1A	20,22,24	<20A3G>
DO-2	Overhead Door Operator	3/4 HP	208 V	3	EC	30 A	3	10 A	Near Unit	LP-1A	20,22,24	<20A3G>
DO-3	Overhead Door Operator	3/4 HP	208 V	3	EC	30 A	3	10 A	Near Unit	LP-1A	26,28,30	<20A3G>
DO-4	Overhead Door Operator	3/4 HP	208 V	3	EC	30 A	3	10 A	Near Unit	LP-1A	26,28,30	<20A3G>
PW-1	Pressure Washer	7-1/2 HP	208 V	3	EC	60 A	3	50 A	Near Unit	LP-1A	15,17,19	<50A3G>
WP-1	Water Pump	2 HP	208 V	1	EC	30 A	2	0 A	At Controller	LP-1B	10,12	<30A3G>

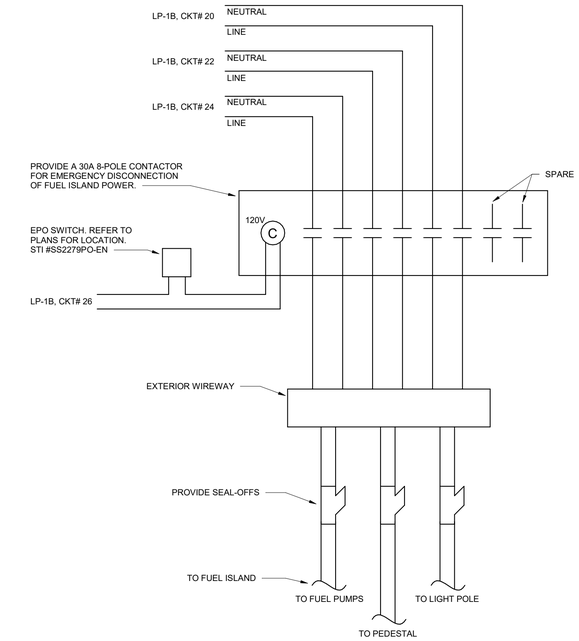
Ceiling Fan Schedule							
Mark	Description	Size	Voltage	Starter Type	Panel	Circuit Number	Manufacturer
CF-1	Ceiling Fan	56"	120 V	EC	LP-1A	13	LEADING EDGE #56001-9D48BW-12003
CF-2	Ceiling Fan	56"	120 V	EC	LP-1A	13	LEADING EDGE #56001-9D48BW-12003
CF-3	Ceiling Fan	56"	120 V	EC	LP-1A	13	LEADING EDGE #56001-9D48BW-12003
CF-4	Ceiling Fan	56"	120 V	EC	LP-1A	13	LEADING EDGE #56001-9D48BW-12003

Light Fixture Schedule							
Mark	Description	Input Power	Lamp Type	Delivered Lumens	Color Temperature	Voltage	Manufacturer
AA	EXTERIOR WALL SCONCE	38 VA	LED	4500 lm	4000 K	120V	LITHONIA #DSX0-LED-P1-40K-T4M-MVOLT-WBA
AA1	SITE LIGHTING DOUBLE HEAD, 20' SS POLE, MOUNTED TO BASE	56 VA	LED	6500 lm	4000 K	120V	LITHONIA #(2)DSX1-LED-P1-40K-T4M-MVOLT/SSS-20-4C-DM19AS-DDBXD
B2	2x2 DIRECT/INDIRECT TROFFER	24 VA	LED	2000 lm	4000 K	120V	LITHONIA #2AVL2-20L-ADP-EZ1-LP840
B2E	2x2 DIRECT/INDIRECT TROFFER EMERGENCY	24 VA	LED	2000 lm	4000 K	120V	LITHONIA #2AVL2-20L-ADP-EZ1-LP840-EL14L
BBE	EXTERIOR WALL SCONCE, EMERGENCY	25 VA	LED	3500 lm	4000 K	120V	LITHONIA #WST-LED-P2-40K-VW-MVOLT-PIR1FC3V-E7WHR
D2	6" DOWNLIGHT	23 VA	LED	2000 lm	4000 K	120V	LITHONIA #LDN6-40/20-LO6AR-LS-WL
D2E	6" DOWNLIGHT, EMERGENCY	23 VA	LED	2000 lm	4000 K	120V	LITHONIA #LDN6-40/20-LO6AR-LS-EL
E	EXIT LIGHT	1 VA	LED			120V	LITHONIA #LQC-W-1-R-EL-N
EM	EMERGENCY BATTERY PACK	2 VA	LED			120V	LITHONIA #ELM2L-UVOLT-LTP
G12	HIGH BAY	79 VA	LED	12000 lm	4000 K	120V	LITHONIA #IBG-12000LM-SEF-PCL-GND-MVOLT-GZ10-40K-80CRI
G18	HIGH BAY	114 VA	LED	18000 lm	4000 K	120V	LITHONIA #IBG-18000LM-SEF-PCL-GND-MVOLT-GZ10-40K-80CRI
G20	VAPOR TIGHT LINEAR	162 VA	LED	20000 lm	4000 K	120V	LITHONIA #FEM-L96-20000LM-IMAFL-MD-MVOLT-GZ10-40K-80CRI
H5	INDUSTRIAL LED STRIP	42 VA	LED	5000 lm	4000 K	120V	LITHONIA #ZL1N-L48-5000LM-FST-MVOLT-40K-80CRI
H5E	INDUSTRIAL LED STRIP, EMERGENCY	42 VA	LED	5000 lm	4000 K	120V	LITHONIA #ZL1N-L48-5000LM-FST-MVOLT-40K-80CRI-E15WLCP
L4	4' RECESSED STRIP LIGHT	20 VA	LED	1500 lm	4000 K	120V	CORONET #LSR3-LED-4-40-LTG2-UNV-DB-W-T15-SD
L8	8' RECESSED STRIP LIGHT	40 VA	LED	3500 lm	4000 K	120V	CORONET #LSR3-LED-8-40-LTG2-UNV-DB-W-T15-SD
L8E	RECESSED STRIP LIGHT, EMERGENCY	40 VA	LED	3500 lm	4000 K	120V	CORONET #LSR3-LED-8-40-LTG2-UNV-DB-W-T15-SD-EM-120V

Mechanical Equipment Schedule														
Equipment Number	Description	Size	Voltage	Phase	Disc. By	Disc. Size	Disc. Poles	Disc. Location	Starter By	Starter Size	Starter Location	Panel	Circuit Number	Feeder	Elec Notes
ACCU-1	Air Cooled Condensing Unit	5-Ton	208 V	3	ELEC	30 A	3	At Unit (WP)	MECH	-	-	LP-1B	31,33,35	<30A3G>	
ACCU-2	Air Cooled Condensing Unit	4-Ton	208 V	3	ELEC	30 A	3	At Unit (WP)	MECH	-	-	LP-1B	37,39,41	<30A3G>	
BLR-1	Knight Fire Tube Boiler	500 W	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	1	<20A2G>	
ECUH-1	Electric Cabinet Unit Heater	4kW	208 V	3	MECH	30 A	3	At Unit	MECH	-	-	LP-1B	14,16,18	<20A3G>	
EF-1	Exhaust Fan	Frac	120 V	1	ELEC	30 A	1	At Unit	ELEC	0	At Unit	LP-1B	7	<20A2G>	2
EF-2	Exhaust Fan	Frac	120 V	1	ELEC	30 A	1	At Unit	ELEC	0	At Unit	LP-1B	9	<20A2G>	3
EF-3	Exhaust Fan	3/4 HP	120 V	1	ELEC	30 A	1	At Unit	ELEC	0	At Unit	LP-1B	11	<30A2G>	4
EF-4	Exhaust Fan	1 HP	208 V	3	ELEC	30 A	3	See Plan	ELEC	0	See Plan	LP-1B	13,15,17	<20A3G>	1
EF-5	Exhaust Fan	1 HP	208 V	3	ELEC	30 A	3	See Plan	ELEC	0	See Plan	LP-1B	19,21,23	<20A3G>	1
EF-6	Exhaust Fan	1 HP	208 V	3	ELEC	30 A	3	See Plan	ELEC	0	See Plan	LP-1B	25,27,29	<20A3G>	1
FURN-1	Furnace	1 HP	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	3	<20A2G>	
FURN-2	Furnace	3/4 HP	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	5	<20A2G>	
P-1	In-Line Mounted Pump	1 HP	208 V	3	ELEC	30 A	3	At Unit	MECH	-	-	LP-1A	35,37,39	<20A3G>	
TF-1	Exhaust Fan	149 W	120 V	1	ELEC	30 A	1	At Unit	ELEC	-	-	LP-1A	18	<20A2G>	2
UH-1	Unit Heater	1/4 HP	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	2	<20A2G>	
UH-2	Unit Heater	1/4 HP	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	4	<20A2G>	
UH-3	Unit Heater	Frac	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	6	<20A2G>	
UH-4	Unit Heater	Frac	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	6	<20A2G>	
UH-5	Unit Heater	Frac	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	6	<20A2G>	
UH-6	Unit Heater	1/2 HP	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	8	<20A2G>	
WHT-1	Commercial Gas Water Heaters	500 W	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1B	30	<20A2G>	
WS-1	Water Softener	500 W	120 V	1	ELEC	30 A	1	At Unit	MECH	-	-	LP-1A	41	<20A2G>	5

Notes:

1. Provide a combination starter/disconnect for control of exhaust fan. Interlock each respective exhaust fan with motorized damper. Refer to plans for location.
2. Provide connection to and from 120V T-STAT provided by Mech.
3. Provide time swtich for control of fan.
4. Interlock with FURN-1. Provide all conduit, wiring, components, connection as required.
5. Provide a GFCI receptacle for cord and plug connection.



1 Fuel Island Contactor Detail
NTS

ThreeRivers PARK DISTRICT
in partnership with
Scott County

CONSULTANT:
ARTEL ARCHITECTS, LTD.
1795 Saint Clair Avenue St. Paul, Minnesota 55105
phone: (651) 696-5186 www.oertelarchitects.com

Paulson & Clark Engineering
Structural | Mechanical | Electrical | Security

REVISIONS / ISSUE

NO.	DATE	DESCRIPTION

PROJECT NAME:
CLEARY LAKE REGIONAL PARK MAINTENANCE BLDG
6246 190th St. E.
Prior Lake, MN 55372

I HEREBY CERTIFY THAT THIS PLAN, SPECIFICATION, OR REPORT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION AND THAT I AM A DULY LICENSED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF MINNESOTA.

Signature
Daniel S. Paulson
Name
23796 License #
July 25, 2019 Date

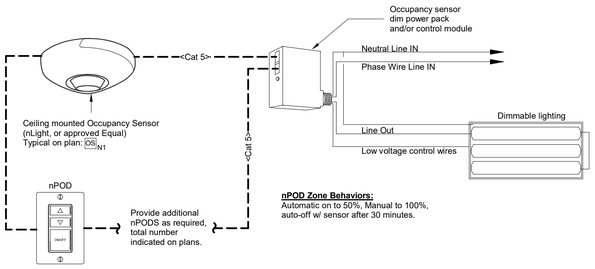
PROJECT NUMBER: 18-42
DATE OF ISSUE: July 25, 2019
DRAWN BY: RTA
CHECKED BY: DSP
SHEET NAME:

ELECTRICAL SCHEDULES

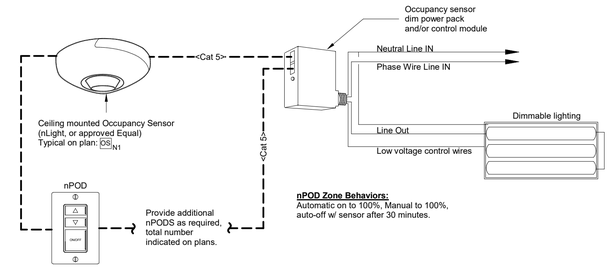
SHEET NO:

E3.1

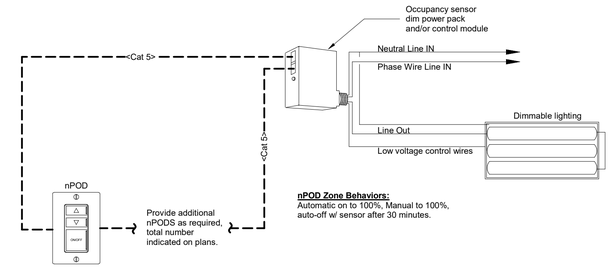
PLOTTED: 7/24/2019 4:34:43 PM FILE NAME: D:\Projects\Cleary Lake r19_twillemssen.rvt



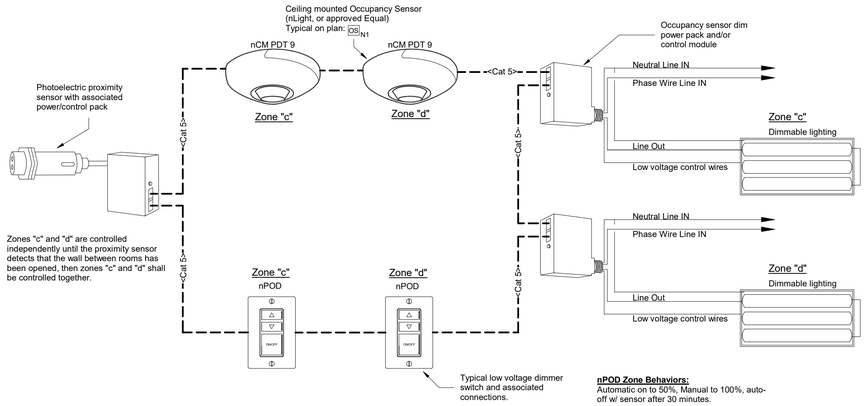
1 LD# Low Voltage Switch, Type I
NTS



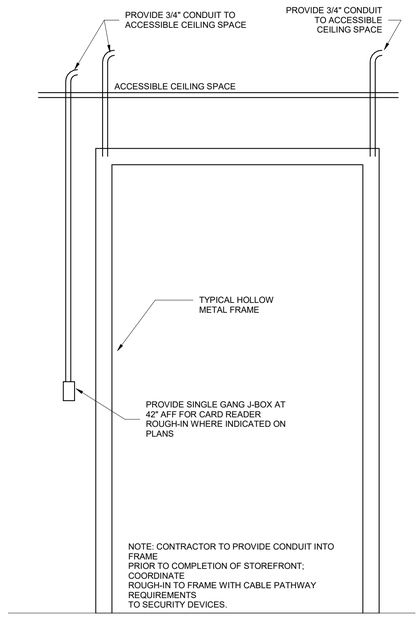
2 LD# Low Voltage Switch, Type II
NTS



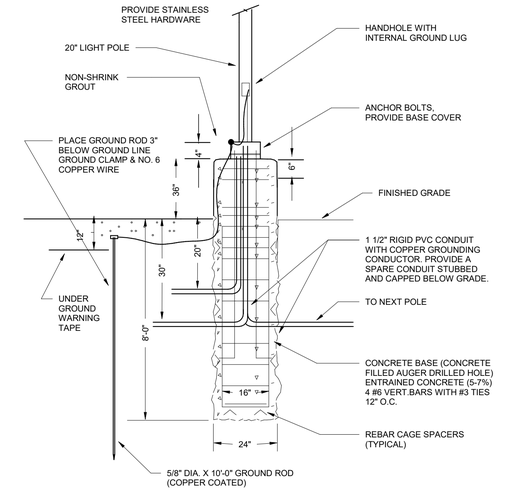
3 LD# Low Voltage Switch, Type III
NTS



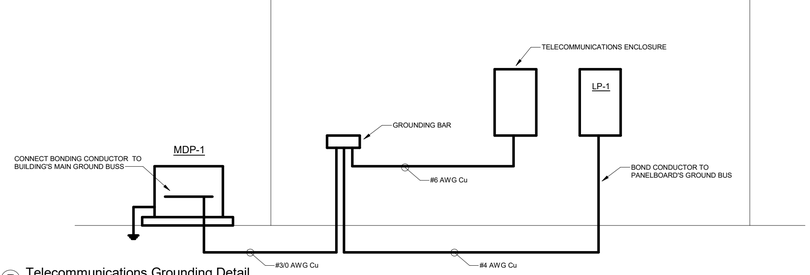
4 LDP w/ Partition Sensor
NTS



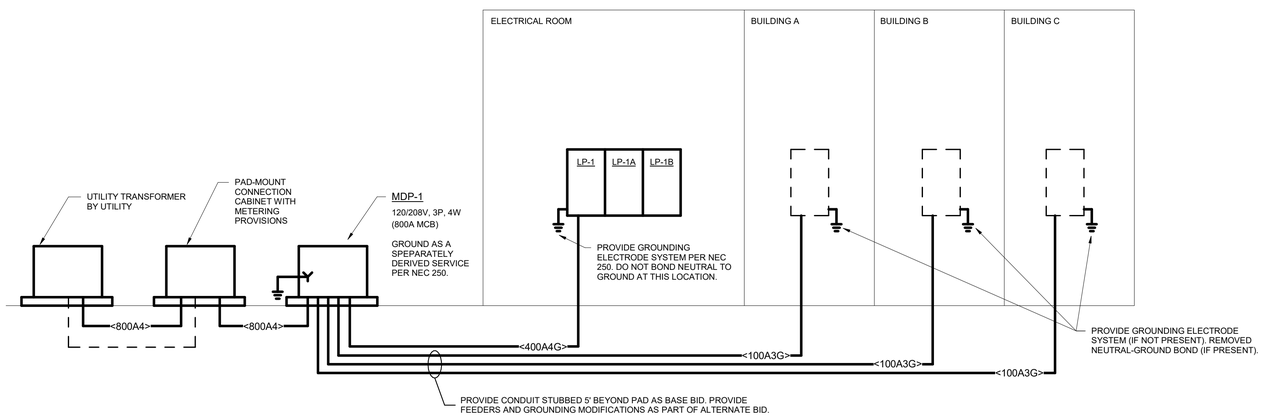
5 Door Rough-in for Security
NTS



6 Exterior Light Pole Base
NTS



7 Telecommunications Grounding Detail
NTS



8 Electrical Riser
NTS

<100A3G> 100A 3 G

Amperage
# of Conductors
G = Ground Required

Notes:
* Optional installation, unless noted otherwise.
(#) = Provide parallel sets of conductors as indicated.

Electrical Feeder Schedule

Feeder Ampacity	3 Wire Feeder	4 Wire Feeder
20 A	1/2"C, 3#12 & 1#12 GND	1/2"C, 4#12 & 1#12 GND
30 A	3/4"C, 3#10 & 1#10 GND	3/4"C, 4#10 & 1#10 GND
50 A	3/4"C, 3#8 & 1#10 GND	1"C, 4#8 & 1#10 GND
60 A	1"C, 3#6 & 1#10 GND	1"C, 4#6 & 1#10 GND
80 A	1"C, 3#4 & 1#8 GND	1 ¼"C, 4#4 & 1#8 GND
100 A	1 ¼"C, 3#3 & 1#8 GND	1 ¼"C, 4#3 & 1#8 GND
125 A	1 ¼""C, 3#1 & 1#6 GND	1 ½"C, 4#1 & 1#6 GND
150 A	1 ½" C, 3#1/0 & 1#6 GND	2"C, 4#1/0 & 1#6 GND
175 A	1 ½"C, 3#2/0 & 1#6 GND	2"C, 4#2/0 & 1#6 GND
200 A	2"C, 3#3/0 & 1#6 GND	2"C, 4#3/0 & 1#6 GND
225 A	2"C, 3#4/0 & 1#4 GND	2 ½"C, 4#4/0 & 1#4 GND
250 A	2 ½"C, 3#250 & 1#4 GND	2 ½"C, 4#250 & 1#4 GND
300 A	2 ½"C, 3#350 & 1#4 GND	3"C, 4#350 & 1#4 GND
400 A	3"C, 3#500 & 1#3 GND	3 ½"C, 4#500 & 1#3 GND
500 A	(2) 2 ½"C, 3#250 & 1#2 GND	(2) 3"C, 4#250 & 1#2 GND
600 A	(2) 3"C, 3#350 & 1#1 GND	(2) 3"C, 4#350 & 1#1 GND
800 A	(2) 3"C, 3#500 & 1#1/0 GND	(2) 3 ½"C, 4#500 & 1#1/0 GND
1000 A	(4) 2 ½"C, 3#250 & 1#2/0 GND	(4) 3"C, 4#250 & 1#2/0 GND
1200 A	(4) 3"C, 3#350 & 1#3/0 GND	(4) 3"C, 4#350 & 1#1/0 GND
1600 A	(4) 3 ½"C, 3#600 & 1#4/0 GND	(4) 4"C, 4#600 & 1#4/0 GND
2000 A	(6) 3"C, 3#400 & 1#250 GND	(6) 3 ½"C, 4#400 & 1#250 GND
2500 A	(7) 3"C, 3#500 & 1#350 GND	(7) 3 ½"C, 4#500 & 1#350 GND
3000 A	(8) 3 ½"C, 3#500 & 1#400 GND	(8) 3 ½"C, 4#500 & 1#400 GND
4000 A	(11) 3 ½"C, 3#500 & 1#500 GND	(11) 4"C, 4#500 & 1#500 GND

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