

Request for Proposal (RFP)

RFP Number	001593
Date Issued	June 14, 2021
Closing Date	June 24, 2021; 2:00pm local time
Procurement Officer	Brad Stefanoni; 620.235.4169; bstefanoni@pittstate.edu
Item	PSU Weede HVAC Upgrades
Agency & Location	Pittsburg State University (PSU) in Pittsburg Kansas
Scope	Pittsburg State University is seeking proposals for upgrades to the HVAC system at the Garfield Weede Building
Period of Contract	One time award
Pre-bid Meeting	9:30AM, Friday, June 18th. Attendees will meet inside the main west entry of the Weede facility at 1701 S Homer St, Pittsburg, Kansas
Bid Submittal	Submit bid by e-mail to bstefanoni@pittstate.edu

1. When communicating, always refer to the Request for Proposal number above.
2. In order to receive consideration for award, one copy of this “Request for Proposal,” a properly completed and signed, must be returned to Pittsburg State University no later than the specified closing time. The University is not responsible for late bids.
3. All prices, terms, and conditions must be shown. Additions or conditions not shown on this bid will not be allowed.
4. Prompt payment discounts will not be considered in determining the low bid.
5. Prices quoted shall be less Federal Excise and State Sales taxes.
6. The PSU Director of Purchasing reserves the right to accept or reject any part of this proposal.
7. Bid results will not be given to individuals over the phone. Written bid results may be obtained by written request from the procurement officer.
8. Contractual Provisions Attachment DA-146a applies to all bids.
9. It is hereby agreed that the bidder will, if required by law, comply with the Kansas Act Against Discrimination, K.S.A. 44-1030 et. Seq.
10. PSU reserves the right to award in the best interest of the university.

Vendor Name	
Base Bid	
Alternate Bid	
Unit Pricing	

Pre-bid meeting will be held at 9:30AM, Friday, June 18th. Attendees will meet inside the main west entry of the Weede facility at 1701 S Homer St, Pittsburg, Kansas.

Contact person: Lindell Haverstic: 620.235.4974 or lhaverstic@pittstate.edu.

Key information for interested bidders:

- The project is tax exempt
- The fieldhouse is available for the interior installations during the month of July and up until August 6th.
- Any interior work after August 6th would need to be coordinated at times the fieldhouse is not in use.
- Successful bidder will need to share fieldhouse with Daktronics for its July video board installation at west end court.
- Exterior site preparation may continue up until August 13th.
- Exterior HVAC equipment may be set and connected upon delivery.
- Per the project manual, alternate #1 calls for demolition of existing gas piping.
- Per the project manual, section 012200 calls for a unit price to provide temporary heat of existing fieldhouse.
- Vendors shall acknowledge receipt of any/all addenda by emailing the procurement officer listed on page 1
- Pre-bid meeting will be held at 9:30AM, Friday, June 18th. Attendees will meet inside the main west entry of the Weede facility at 1701 S Homer St, Pittsburg, Kansas

General Provisions/Signature

Tax Clearance Certification: Bid submittals of \$25,000 or more shall include a copy of a Tax Clearance Certification. Tax Clearances may be obtained from the Kansas Dept. of Revenue (KDOR):

<http://www.ksrevenue.org/taxclearance.html>

W9 Form: Vendors who are new to PSU should submit a copy of their W-9 with bid response. The form can be downloaded at www.irs.gov/pub/irs-pdf/fw9.pdf

DA-146a Contractual Provisions: The bidder agrees to accept the provisions of form DA-146a, Contractual Provisions Attachment which is incorporated into all contracts with the State <http://www.da.ks.gov/purch/DA-146a.pdf>

NEW MATERIALS, SUPPLIES, OR EQUIPMENT: Unless otherwise specified, all materials, supplies or equipment offered by a vendor shall be new, and unused in any regard. All materials, supplies and equipment shall be first class in all respects. Seconds or flawed items will not be acceptable. All materials, supplies or equipment shall be suitable for their intended purpose and, unless otherwise specified, fully assembled and ready for use on delivery.

COMPARABLE PRODUCTS: Bids on comparable products are invited. Indicate appropriate items, brands, model numbers, and specifications. Minor deviations in size and operational characteristics from those set forth in the specification will be considered when such deviations do not alter nor deter Pittsburg State University from accomplishing its intended usage or function. **Each bidder must clearly indicate in writing where (if any) their product characteristics deviate from these specifications and explain how their product accomplishes the desired function even though product characteristics may be different.**

ACCEPTANCE OR REJECTION: PSU reserves the right to accept or reject any or all bids or part of a bid; to waive any informalities or technicalities; clarify any ambiguities in bids; and unless otherwise specified, to accept any item in the bid.

PAYMENT: Payment will be made upon receipt of shipment by PSU.

FREIGHT COST INFORMATION: FOB Destination, Freight Prepaid, and Allowed.

The undersigned certifies that he does not have any substantial conflict of interest sufficient to influence the bidding process on this bid. A conflict of substantial interest is one which a reasonable person would think would compromise the open competitive bid process.

- Legal Name of Person, Firm or Corporation:
- Payment Terms:
- Telephone Number:
- E-mail Address:
- **Signature:** _____
- **Date:** _____

CONTRACTUAL PROVISIONS ATTACHMENT

Important: This form contains mandatory contract provisions and must be attached to or incorporated in all copies of any contractual agreement. If it is attached to the vendor/contractor's standard contract form, then that form must be altered to contain the following provision:

The Provisions found in Contractual Provisions Attachment (Form DA-146a, Rev. 07-19), which is attached hereto, are hereby incorporated in this contract and made a part thereof.

The parties agree that the following provisions are hereby incorporated into the contract to which it is attached and made a part thereof, said contract being the _____ day of _____, 20____.

1. **Terms Herein Controlling Provisions:** It is expressly agreed that the terms of each and every provision in this attachment shall prevail and control over the terms of any other conflicting provision in any other document relating to and a part of the contract in which this attachment is incorporated. Any terms that conflict or could be interpreted to conflict with this attachment are nullified.
2. **Kansas Law and Venue:** This contract shall be subject to, governed by, and construed according to the laws of the State of Kansas, and jurisdiction and venue of any suit in connection with this contract shall reside only in courts located in the State of Kansas.
3. **Termination Due To Lack Of Funding Appropriation:** If, in the judgment of the Director of Accounts and Reports, Department of Administration, sufficient funds are not appropriated to continue the function performed in this agreement and for the payment of the charges hereunder, State may terminate this agreement at the end of its current fiscal year. State agrees to give written notice of termination to contractor at least thirty (30) days prior to the end of its current fiscal year and shall give such notice for a greater period prior to the end of such fiscal year as may be provided in this contract, except that such notice shall not be required prior to ninety (90) days before the end of such fiscal year. Contractor shall have the right, at the end of such fiscal year, to take possession of any equipment provided State under the contract. State will pay to the contractor all regular contractual payments incurred through the end of such fiscal year, plus contractual charges incidental to the return of any such equipment. Upon termination of the agreement by State, title to any such equipment shall revert to contractor at the end of the State's current fiscal year. The termination of the contract pursuant to this paragraph shall not cause any penalty to be charged to the agency or the contractor.
4. **Disclaimer Of Liability:** No provision of this contract will be given effect that attempts to require the State of Kansas or its agencies to defend, hold harmless, or indemnify any contractor or third party for any acts or omissions. The liability of the State of Kansas is defined under the Kansas Tort Claims Act (K.S.A. 75-6101, *et seq.*).
5. **Anti-Discrimination Clause:** The contractor agrees: (a) to comply with the Kansas Act Against Discrimination (K.S.A. 44-1001, *et seq.*) and the Kansas Age Discrimination in Employment Act (K.S.A. 44-1111, *et seq.*) and the applicable provisions of the Americans With Disabilities Act (42 U.S.C. 12101, *et seq.*) (ADA), and Kansas Executive Order No. 19-02, and to not discriminate against any person because of race, color, gender, sexual orientation, gender identity or expression, religion, national origin, ancestry, age, military or veteran status, disability status, marital or family status, genetic information, or political affiliation that is unrelated to the person's ability to reasonably perform the duties of a particular job or position; (b) to include in all solicitations or advertisements for employees, the phrase "equal opportunity employer"; (c) to

comply with the reporting requirements set out at K.S.A. 44-1031 and K.S.A. 44-1116; (d) to include those provisions in every subcontract or purchase order so that they are binding upon such subcontractor or vendor; (e) that a failure to comply with the reporting requirements of (c) above or if the contractor is found guilty of any violation of such acts by the Kansas Human Rights Commission, such violation shall constitute a breach of contract and the contract may be cancelled, terminated or suspended, in whole or in part, by the contracting state agency or the Kansas Department of Administration; (f) Contractor agrees to comply with all applicable state and federal anti-discrimination laws and regulations; (g) Contractor agrees all hiring must be on the basis of individual merit and qualifications, and discrimination or harassment of persons for the reasons stated above is prohibited; and (h) if it is determined that the contractor has violated the provisions of any portion of this paragraph, such violation shall constitute a breach of contract and the contract may be canceled, terminated, or suspended, in whole or in part, by the contracting state agency or the Kansas Department of Administration.

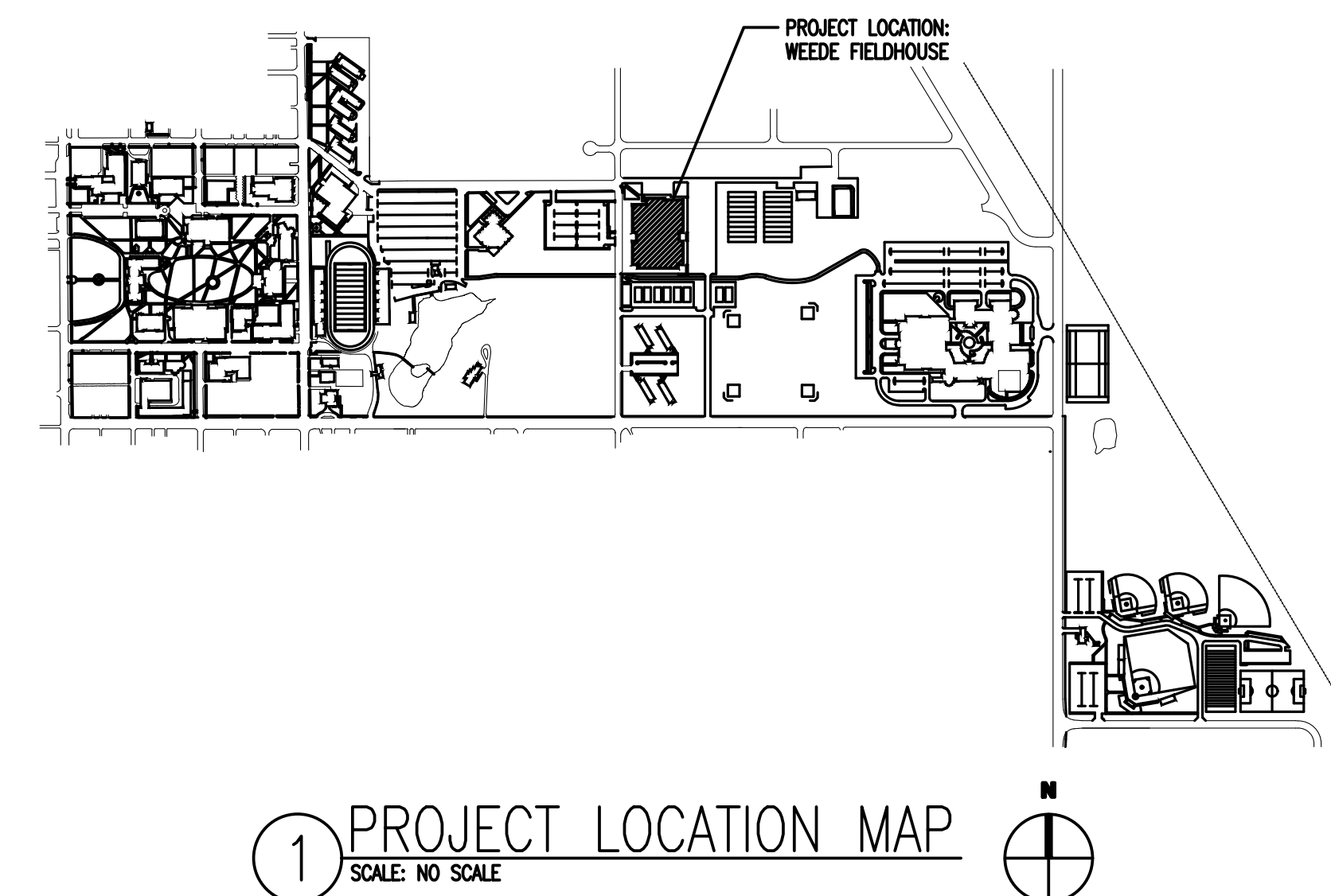
6. **Acceptance of Contract:** This contract shall not be considered accepted, approved or otherwise effective until the statutorily required approvals and certifications have been given.
7. **Arbitration, Damages, Warranties:** Notwithstanding any language to the contrary, no interpretation of this contract shall find that the State or its agencies have agreed to binding arbitration, or the payment of damages or penalties. Further, the State of Kansas and its agencies do not agree to pay attorney fees, costs, or late payment charges beyond those available under the Kansas Prompt Payment Act (K.S.A. 75-6403), and no provision will be given effect that attempts to exclude, modify, disclaim or otherwise attempt to limit any damages available to the State of Kansas or its agencies at law, including but not limited to, the implied warranties of merchantability and fitness for a particular purpose.
8. **Representative's Authority to Contract:** By signing this contract, the representative of the contractor thereby represents that such person is duly authorized by the contractor to execute this contract on behalf of the contractor and that the contractor agrees to be bound by the provisions thereof.
9. **Responsibility for Taxes:** The State of Kansas and its agencies shall not be responsible for, nor indemnify a contractor for, any federal, state or local taxes which may be imposed or levied upon the subject matter of this contract.
10. **Insurance:** The State of Kansas and its agencies shall not be required to purchase any insurance against loss or damage to property or any other subject matter relating to this contract, nor shall this contract require them to establish a "self-insurance" fund to protect against any such loss or damage. Subject to the provisions of the Kansas Tort Claims Act (K.S.A. 75-6101, *et seq.*), the contractor shall bear the risk of any loss or damage to any property in which the contractor holds title.
11. **Information:** No provision of this contract shall be construed as limiting the Legislative Division of Post Audit from having access to information pursuant to K.S.A. 46-1101, *et seq.*
12. **The Eleventh Amendment:** "The Eleventh Amendment is an inherent and incumbent protection with the State of Kansas and need not be reserved, but prudence requires the State to reiterate that nothing related to this contract shall be deemed a waiver of the Eleventh Amendment."
13. **Campaign Contributions / Lobbying:** Funds provided through a grant award or contract shall not be given or received in exchange for the making of a campaign contribution. No part of the funds provided through this contract shall be used to influence or attempt to influence an officer or employee of any State of Kansas agency or a member of the Legislature regarding any pending legislation or the awarding, extension, continuation, renewal, amendment or modification of any government contract, grant, loan, or cooperative agreement.

PITTSBURG STATE UNIVERSITY

1701 BROADWAY ST
PITTSBURG, KS

WEEDE FIELDHOUSE HVAC UPGRADES

PROJECT NUMBERS
A-014285
2150001628



DRAWING INDEX - PACKAGE 1 (DAKTRONICS)

GENERAL

G0.00 COVER SHEET

ELECTRICAL

E0.00.A	ELECTRICAL LEGEND
E1.01A.A	ELECTRICAL POWER PLAN
E1.01B.A	ELECTRICAL POWER PLAN
E1.01C.A	ELECTRICAL POWER PLAN
E1.01D.A	ELECTRICAL POWER PLAN
E1.02A.A	ELECTRICAL POWER PLAN
E1.02B.A	ELECTRICAL POWER PLAN
E1.02C.A	ELECTRICAL POWER PLAN
E8.00.A	ELECTRICAL ONE-LINES

DRAWING INDEX - PACKAGE 2 (HVAC)

GENERAL

G0.00 COVER SHEET

STRUCTURAL

S0.00 STRUCTURAL PLANS AND SECTIONS

MECHANICAL

M0.00	MECHANICAL COVER SHEET
M1.01A	MECHANICAL HVAC PLAN
M1.01B	MECHANICAL HVAC PLAN
M1.02A	MECHANICAL HVAC PLAN
M1.02B	MECHANICAL HVAC PLAN
M3.00	MECHANICAL DETAILS
M4.00	MECHANICAL SCHEDULES
M5.00	MECHANICAL CONTROLS
MD1.01A	MECHANICAL HVAC DEMO PLAN
MD1.01B	MECHANICAL HVAC DEMO PLAN
MD1.02A	MECHANICAL HVAC DEMO PLAN
MD1.02B	MECHANICAL HVAC DEMO PLAN
MD1.02C	MECHANICAL HVAC DEMO PLAN
MD1.02D	MECHANICAL HVAC DEMO PLAN

ELECTRICAL

E0.00	ELECTRICAL LEGEND
E1.00	ELECTRICAL SITE PLAN
E1.01A	ELECTRICAL POWER PLAN
E1.01B	ELECTRICAL POWER PLAN
E1.01C	ELECTRICAL POWER PLAN
E1.01D	ELECTRICAL POWER PLAN
E1.01F	ELECTRICAL POWER PLAN
E1.02A	ELECTRICAL POWER PLAN
E1.02B	ELECTRICAL POWER PLAN
E1.02D	ELECTRICAL POWER PLAN
E8.00	ELECTRICAL ONE-LINES
ED1.02A	ELECTRICAL POWER DEMO PLAN
ED1.02B	ELECTRICAL POWER DEMO PLAN
ED1.02C	ELECTRICAL POWER DEMO PLAN
ED1.02D	ELECTRICAL POWER DEMO PLAN

PLUMBING

P0.00	PLUMBING GENERAL NOTES AND DETAILS
P1.00	PLUMBING SITE PLAN
PD1.02A	PLUMBING DEMO FLOOR PLAN
PD1.02B	PLUMBING DEMO FLOOR PLAN
PD1.02C	PLUMBING DEMO FLOOR PLAN
PD1.02D	PLUMBING DEMO FLOOR PLAN
PD1.02B	PLUMBING DEMO FLOOR PLAN

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
1701 S BROADWAY ST
PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY:

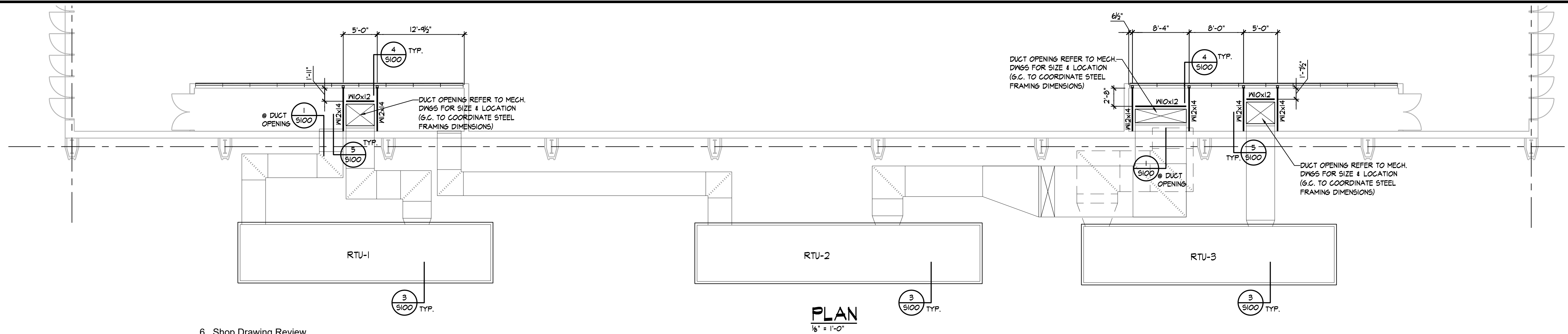
HENDERSON
ENGINEERS
8348 LENOVA DRIVE, SUITE 300
LENOVA, KS 66214
TEL: 913.742.3000 FAX: 913.742.5001
WWW.HENDERSONENGINEERS.COM
2150001628
KS CORPORATE NUMBER: E-325
12/31/21

COVER SHEET

A-014285

G0.00

100% BID
AND PERMIT



PLAN
1/8" = 1'-0"

1. General Information

- A. The contractor shall verify dimensions and conditions before construction and notify the engineer of any discrepancies, inconsistencies, or difficulties affecting the work before proceeding.
- B. The contractor shall coordinate all disciplines, verifying size and location of all openings, whether shown on structural drawings or not, as called for on architectural, mechanical, or electrical drawings. In the case of work in an existing building the contractor shall scan existing structure to locate all rebar in the area of the new core/opening using ground penetrating radar and notify the engineer of record for review prior to coring/cutting. Conflicts, inconsistencies, or other difficulties affecting structural work shall be called to the architect or engineer's attention for direction before proceeding.
- C. All design and construction work for this project shall conform to the requirements of the following governing design codes:
 - 1.) International Building Code (IBC 2018) as amended by the city of Pittsburg, Kansas.
 - 2.) Minimum Design Loads for Buildings and Other Structures (ASCE7-16)
 - 3.) Specification for Structural Steel Buildings (AISC 360-16)
 - Member Design Basis is Allowable Stress Design (ASD)
 - Connection Design Basis is Allowable Stress Design (ASD)
 - 4.) Structural Welding Code (AWS D1.3-98)
 - 5.) Building Code Requirements for Structural Concrete (ACI 318-14)
 - 6.) Building Code Requirements for Masonry Structures (TMS 402/602-16)
 - 7.) North American Specification for the Design of Cold-Formed Steel Structural Members (ANSI S100-07/S1-1)
 - 8.) National Design Specification (NDS) for Wood Construction with 2012 Supplements (ANSI/AWC NDS-2012)
 - 9.) Special Design Provisions for Wind and Seismic (AWC SDPWS-2008)
- D. These drawings are for this specific project and no other use is authorized.

2. Structural Load Design Criteria

- A. Roof Live = 30 psf; Roof Dead = 15 psf
- B. Snow: Pg = 20 psf, Pf = 14psf, Is = 1.0, Ce = 1.0, Ct = 1.0, Drift per ASCE/SEI 7
- C. This project is designed to resist the most critical effects resulting from the load combinations of section 1605.3 of the International Building Code.

3. Concrete

- A. All concrete shall have a minimum design compressive strength of 4500 psi in 28 days, with not less than 560 pounds of cement per cubic yard of concrete, not over 5 gallons of water per 100 pounds of cement, with 6% +/- 1% air entrainment, and a maximum of 4 inches of slump.
- B. The preceding minimum mix requirements may have water-reducing admixtures conforming to ASTM C494 added to the mix at manufacturer's dosage rates for improved workability.
- C. The preceding minimum mix requirements may have up to 15% maximum of the cement content replaced with an approved ASTM C618 Class C fly ash, provided the total minimum cementitious content is not reduced.
- D. Combined aggregate (coarse plus fine) for all concrete shall be well graded from coarsest to finest with no more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 and finer sieves. Submit this gradation report with the concrete mix design shop drawings.
- E. All concrete is reinforced concrete unless specifically called out as unreinforced. Reinforce all concrete not otherwise shown with same steel as in similar sections or areas. Any details not shown shall be detailed per ACI 315 and meet requirements of ACI 318, current editions.
- F. Control joints in dirt formed slab to be as shown on plans. Where not shown, limit controlled areas to not more than 144 square feet, or 12 feet on any side. Slab panel side ratio shall not exceed 1 1/2 to 1.
- G. Contractor shall verify that all concrete inserts, reinforcing and embedded items are correctly located and rigidly secured prior to concrete placement.
- H. No aluminum items shall be embedded in any concrete.

4. Reinforcing Steel

- A. All reinforcing steel shall conform to the requirements of ASTM A615 or A706 grade 60 steel. Welded plain wire fabric shall be supplied in sheets and conform to the requirements of ASTM A185.
- B. Clear minimum coverage of concrete over reinforcing steel shall be as follows:
 - 1.) Slabs: 1"
 - 2.) Other: 2"
- C. All coverage shall be nominal bar diameter minimum.
- D. All dowels shall be the same size and spacing as adjoining main bars (splice lap 48 bar diameters or 24" minimum unless noted otherwise).
- E. At corners of all walls, beams, and grade beams supply corner bars (minimum 2'-0" in each direction or 48 bar diameters) in outside face of wall, matching size and spacing of horizontal bars. Where there are no vertical bars in outside face of wall, supply 3-#4 vertical support bars for corner bars.
- F. Bars marked continuous and all vertical steel shall be lapped 48 bar diameters (2'-0" minimum) at splices and embedments, unless shown otherwise. Splice top bars near midspan and splice bottom bars over supports, unless noted otherwise.
- G. Accessories shall be as specified in latest edition of the ACI Detailing Handbook and the concrete Reinforcing Steel Institute Design Handbook. Maximum accessory spacing shall be 4'-0" on center, and all accessories on exposed surfaces are to have plastic coated feet.

5. Structural Steel

- A. All structural steel beams and columns shall be ASTM A992, grade 50 steel and all miscellaneous steel shall be ASTM A36 grade steel (except at moment connections where plates shall be ASTM A572, grade 50). Hollow Structural Sections (HSS) shall be ASTM A500, grade B. Fabrication and erection shall be in accordance with AISC 303-05 "Code of Standard Practice for Steel Buildings and Bridges" in the 13th Edition of the AISC Steel Construction Manual.
- B. All welding shall conform to the recommendations of the AWS.
- C. All exterior steel and connections, and brick relief angles shall be hot-dip galvanized.
- D. All openings in steel existing joist roof to have 3x3x1/4 angle frame set between joists. Support mechanical equipment with 4x4x5/16 angles laid between joists framed to 4x4x5/16 angles (length equals mechanical unit dimension plus distance each end to next panel point) laid parallel to and welded to top and/or bottom cord of joists to distribute load to joist panel points.

6. Shop Drawing Review

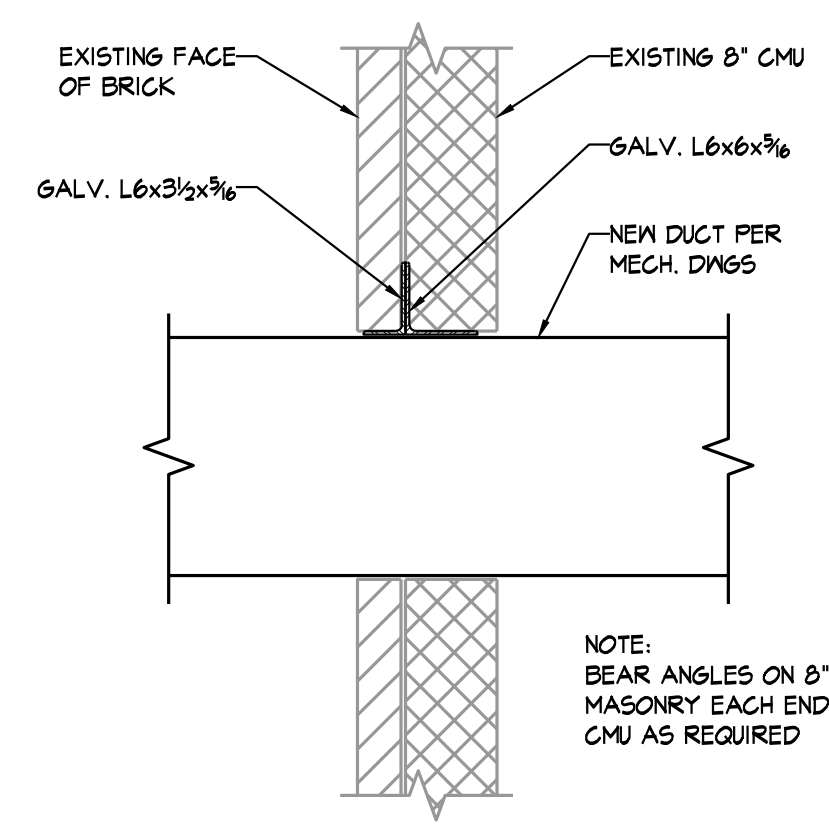
- A. Bob D. Campbell and Company, Inc. will review the General Contractor's (GC) shop drawings and related submittals (as indicated below) with respect to the ability of the detailed work, when complete, to be a properly functioning integral element of the overall structural system designed by Bob D. Campbell and Company, Inc.
- B. Prior to submittal of a shop drawing or any related material to Bob D. Campbell and Company, Inc., the GC shall:
 - 1.) Review each submission for conformance with the means, methods, techniques, sequences and operations of construction and safety precautions and programs incidental thereto, all of which are the sole responsibility of the GC.
 - 2.) Review and approve each submission.
 - 3.) Stamp each submission as approved.
- C. Bob D. Campbell and Company, Inc. shall assume that no submission comprises a variation unless the GC advises Bob D. Campbell and Company, Inc. with written documentation.
- D. Bob D. Campbell and Company, Inc. shall review shop drawings and related materials with comments provided that each submission has met the above requirements. Bob D. Campbell and Company, Inc. shall return without comment unrequired material or submissions without GC approval stamp.
- E. Shop drawings and related material (if any) required are indicated below. Should Bob D. Campbell and Company, Inc. require more than ten (10) working days to perform the review, Bob D. Campbell and Company, Inc. shall so notify the GC.
 - 1.) Concrete mix designs and material certificates including admixtures and compounds applied to the concrete after placement.
 - 2.) Reinforcing steel shop drawings including erection drawings and bending details. Bar list will not be reviewed for correct quantities.
 - 3.) Structural steel shop drawings including erection drawings and piece details. Include joist, decking and connector submittals. Include miscellaneous framing specified on the structural drawings, but do not submit framing specified on non-structural drawings for Bob D. Campbell and Company, Inc. review.

7. Statement of Structural Special Inspections

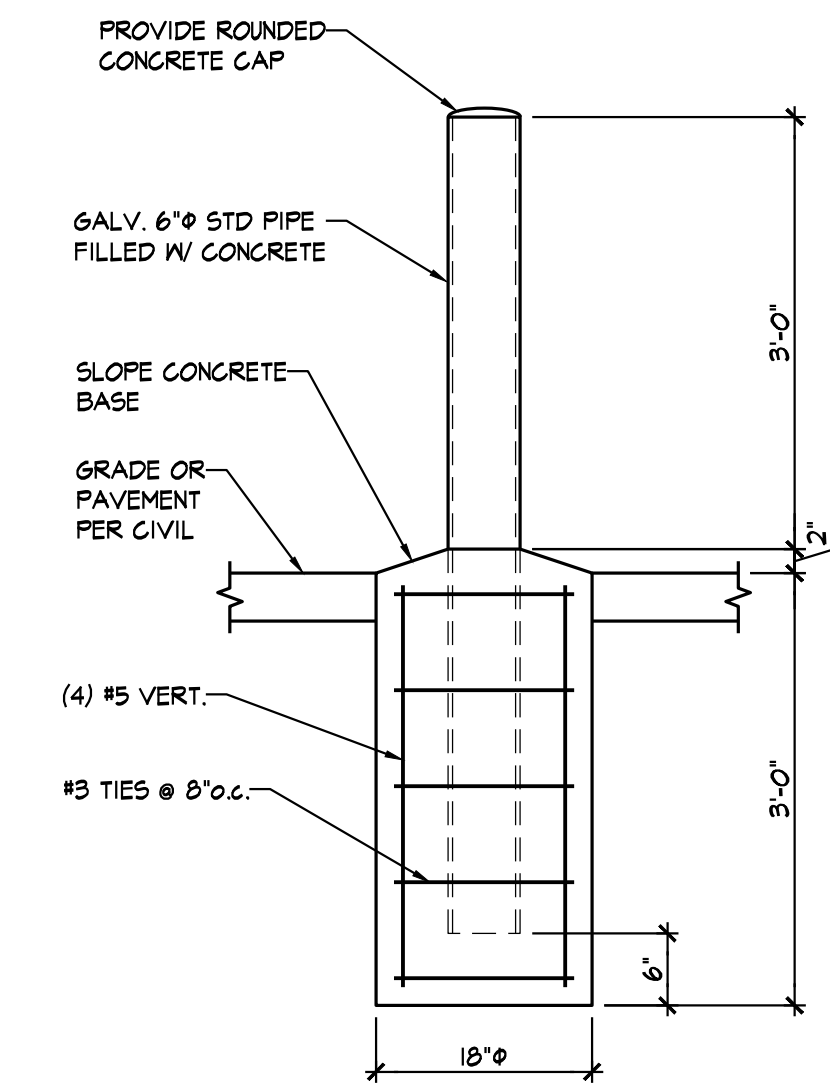
- A. The structural design for this project is based on completion of special inspections during construction in accordance with section 1704 of the International Building Code. The owner shall employ one or more qualified special inspectors to provide the required special inspections.
- B. The special inspector shall furnish inspection reports to the building official, owner, architect and structural engineer, and any other designated person.
- C. All discrepancies shall be brought to the immediate attention of the contractor for correction, then, if uncorrected, to the proper design authority, building official and structural engineer.
- D. The special inspector shall submit a final signed report stating that the work requiring special inspection was, to the best of the inspector's knowledge, in conformance with the approved plans and specifications and the applicable workmanship provisions of the building code.
- E. The following inspections and tests are required with the frequency (continuous or periodic) as defined within the referenced section or standard listed below. The General Contractor shall provide notification to the inspector when items requiring inspection are ready to be inspected and provide access for those inspections.
 1. Shop Fabrication - structural steel and steel bar joist per Section 1704.2.5 unless AISC certified shop
 2. Steel Construction per Section 1705.2 and the quality assurance requirements of AISC 341 Chapter J (as referenced by AISC 360)
 3. Concrete Construction per Section 1705.3 and Table 1705.3
 - a. Reinforcing Steel Placement
 - b. Design Mix Verification
 - c. Concrete Sampling and Testing
 - d. Concrete Placement
 - e. Concrete Curing
 - f. Formwork Shape, Location and Dimensions

8. Copyright and Disclaimer

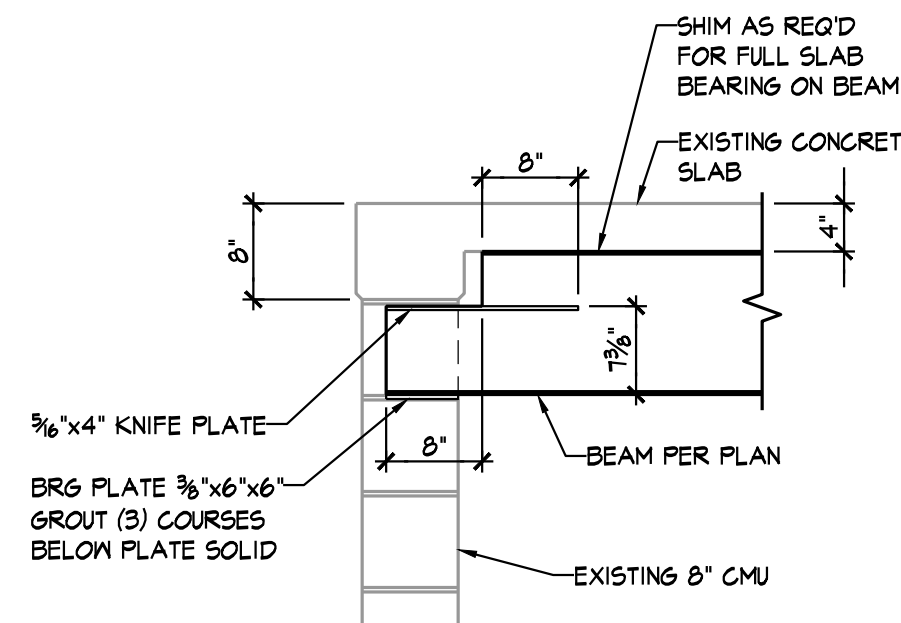
- A. All drawings in the structural set (S-series drawings) are the copyrighted work of Bob D. Campbell and Company, Inc. These drawings may not be photocopied, traced, or copies in any manner without the written permission of Bob D. Campbell and Company, Inc. Exception: Original drawings may be printed for distribution to the owner, architect, and general contractor for coordination, bidding, and construction. Subcontractors may not reproduce these drawings for any purpose or in any manner.
- B. I, Wayne E. Davis, P.E., registered engineer and a representative of Bob D. Campbell and Company, Inc., do hereby accept professional responsibility as required by the professional registration laws of this state for the structural design drawings consisting of S-series drawings. I hereby disclaim responsibility for all other drawings in the construction document package, they being the responsibility of other design professionals whose seals and signed statements may appear elsewhere in the construction document package.



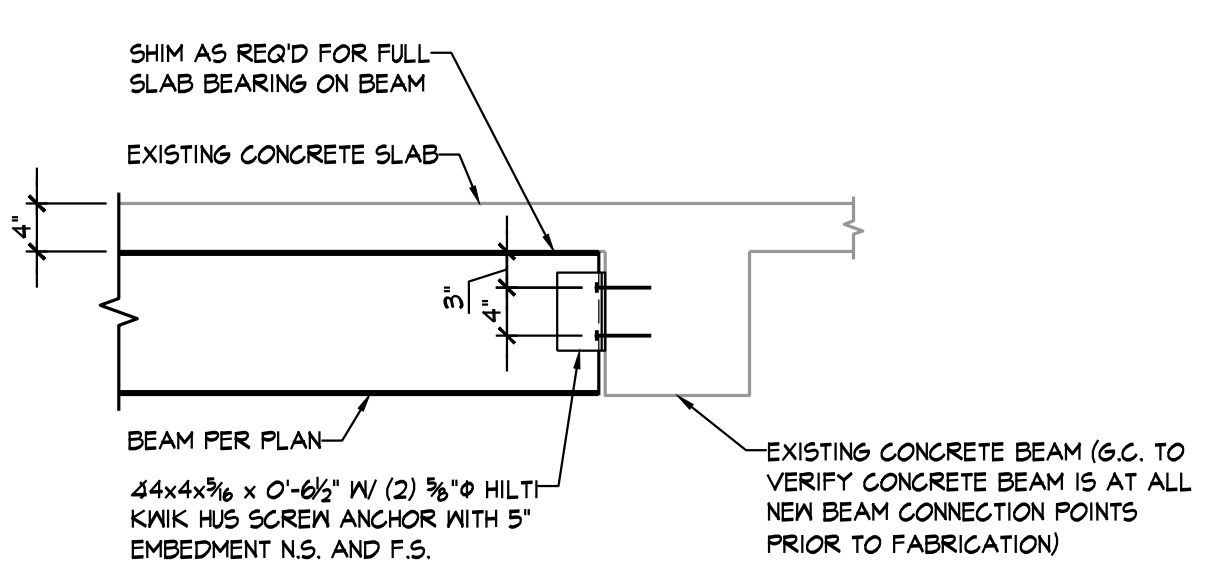
SECTION 1
3/8" = 1'-0" S100



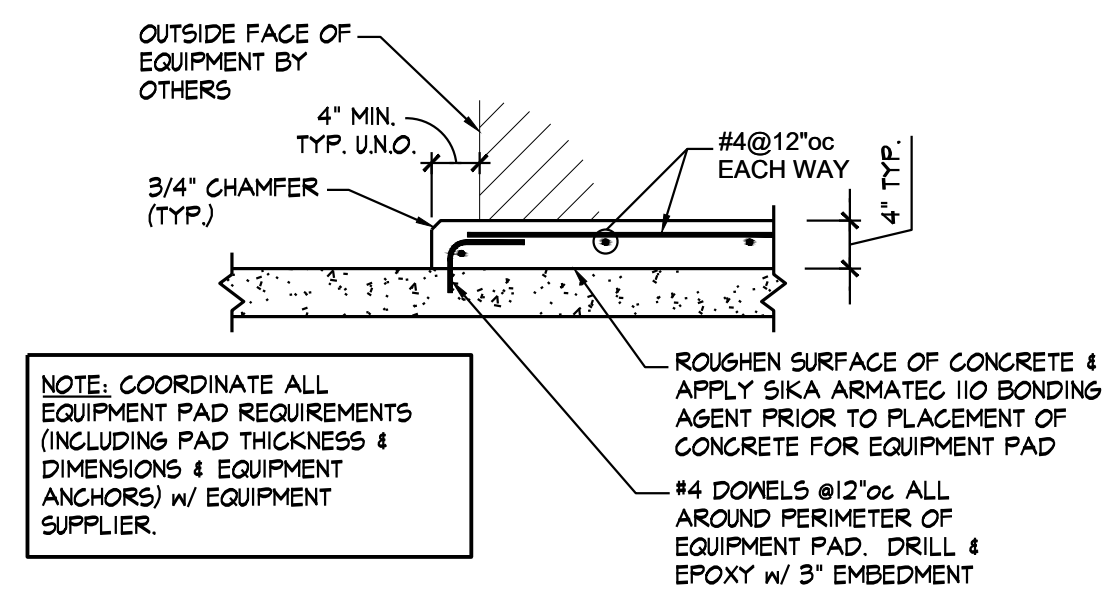
TYPICAL PIPE BOLLARD DETAIL
3/8" = 1'-0" S100



SECTION 4
3/8" = 1'-0" S100



SECTION 5
3/8" = 1'-0" S100



TYPICAL EQUIPMENT PAD
3/8" = 1'-0" S100



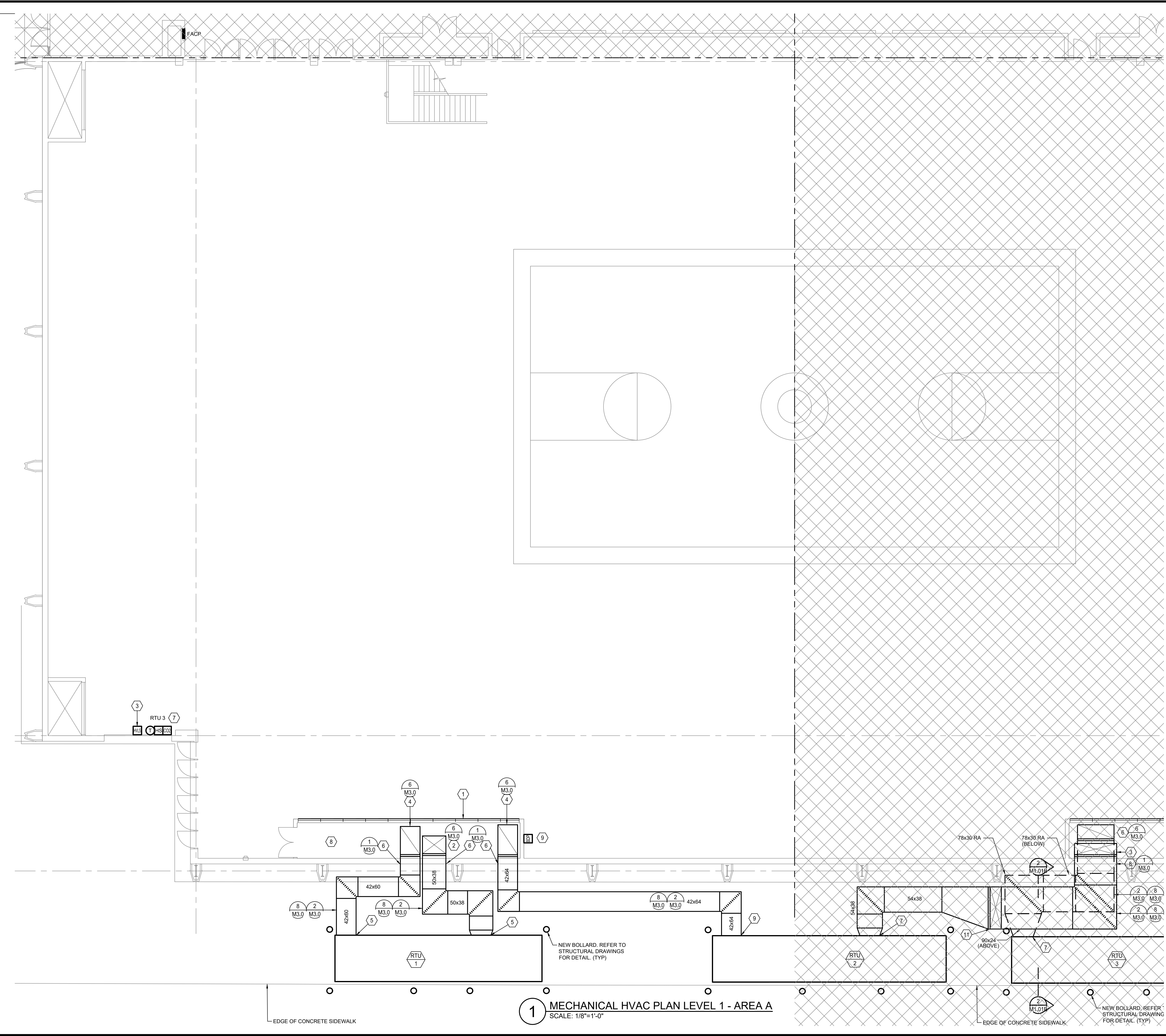
STRUCTURAL PLANS AND SECTIONS

A-014285

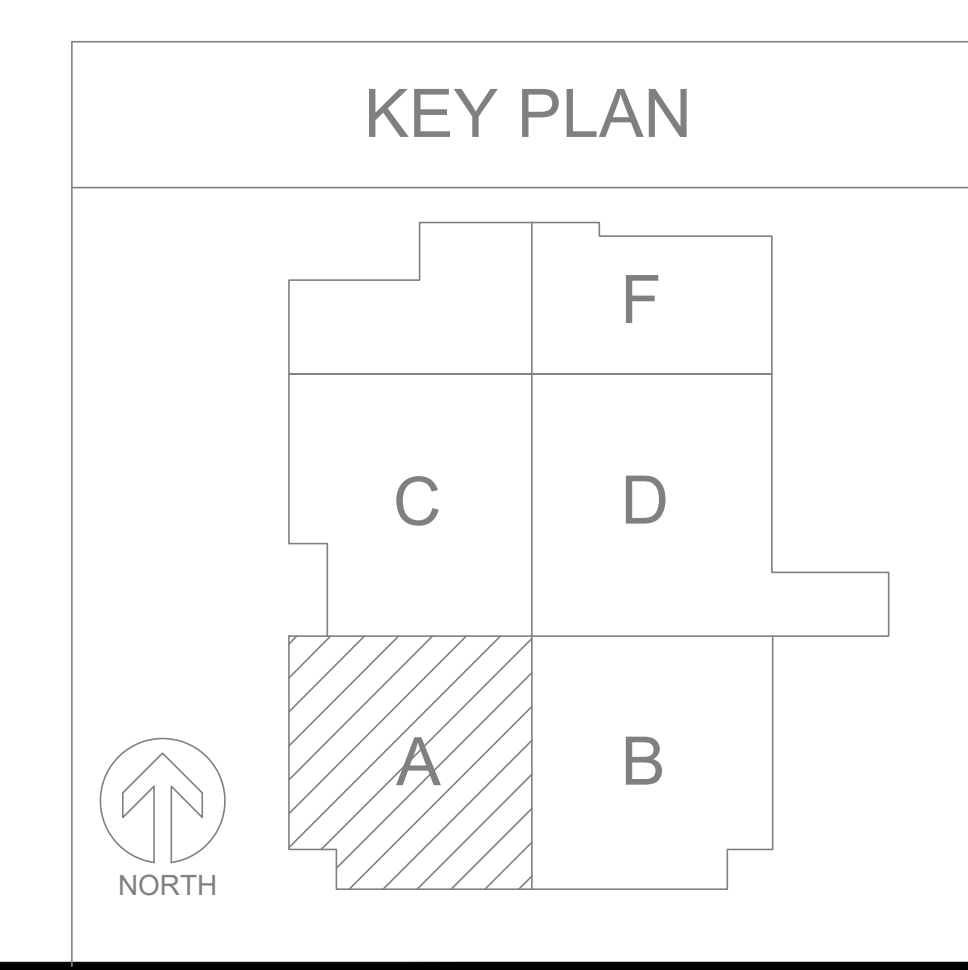
S100

100% BID AND PERMIT

- MECHANICAL PLAN NOTES:**
1. REUSE EXISTING 48"x34" GRILLES MOUNTED LOW IN WALL FOR RETURN AIR. VACUUM GRILLES AND WIPE THEM CLEAN OF ANY DUST OR DEBRIS.
 2. 50x38 SUPPLY AIR UP WALL AND THRU CEILING OF STORAGE ROOM TO TRUSS SPACE. RE: M1.02A FOR CONTINUATION.
 3. LOCATE HVLS 1 CONTROLLER ON WALL ADJACENT TO RTU 1 THERMOSTAT, HUMIDITY SENSOR, AND CARBON DIOXIDE SENSOR.
 4. TURN RETURN AIR DUCT UP IN STORAGE ROOM AND ROUTE UP TO 4FT BELOW CEILING. COVER RETURN AIR OPENING IN RETURN AIR DUCT WITH 1/2" GALVANIZED STEEL BIRD SCREEN. STICK PIN 2" THICK FIBROUS BLACK DUCT LINER TO THE UNDERSIDE OF THE CEILING ABOVE RETURN DUCT FOR SOUND ABSORPTION.
 5. TRANSITION FROM UNIT OPENING SIZE TO DUCT SIZE INDICATED ON PLAN. BOTTOM OF DUCT SHALL BE MINIMUM 24" ABOVE GRADE.
 6. ROUTE DUCT THROUGH PERIMETER WALL INTO STORAGE ROOM. REFER TO STRUCTURAL DRAWINGS FOR EXTERIOR WALL PENETRATION REQUIREMENTS.
 7. PROVIDE SURFACE MOUNTED 1" CONDUIT FOR CONTROL WIRE FROM RTU CONTROLLER TO EACH RTU SENSOR. PAINT TO MATCH ADJACENT SURFACE.
 8. COORDINATE WITH DIVISION 28 CONTRACTOR TO RELOCATE EXISTING STORAGE ROOM LIGHTS AS NEEDED TO ROUTE DUCTWORK IN STORAGE ROOM.
 9. PROVIDE SURFACE MOUNTED CONDUIT FOR CONTROL WIRE FROM RTU CONTROLLERS TO BUILDING PRESSURE SENSOR. PAINT TO MATCH ADJACENT SURFACE.



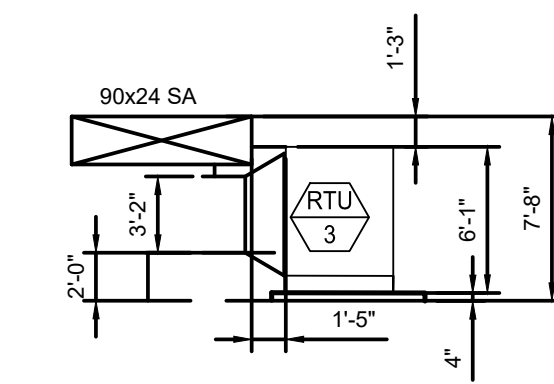
1 MECHANICAL HVAC PLAN LEVEL 1 - AREA A
 SCALE: 1/8"=1'-0"



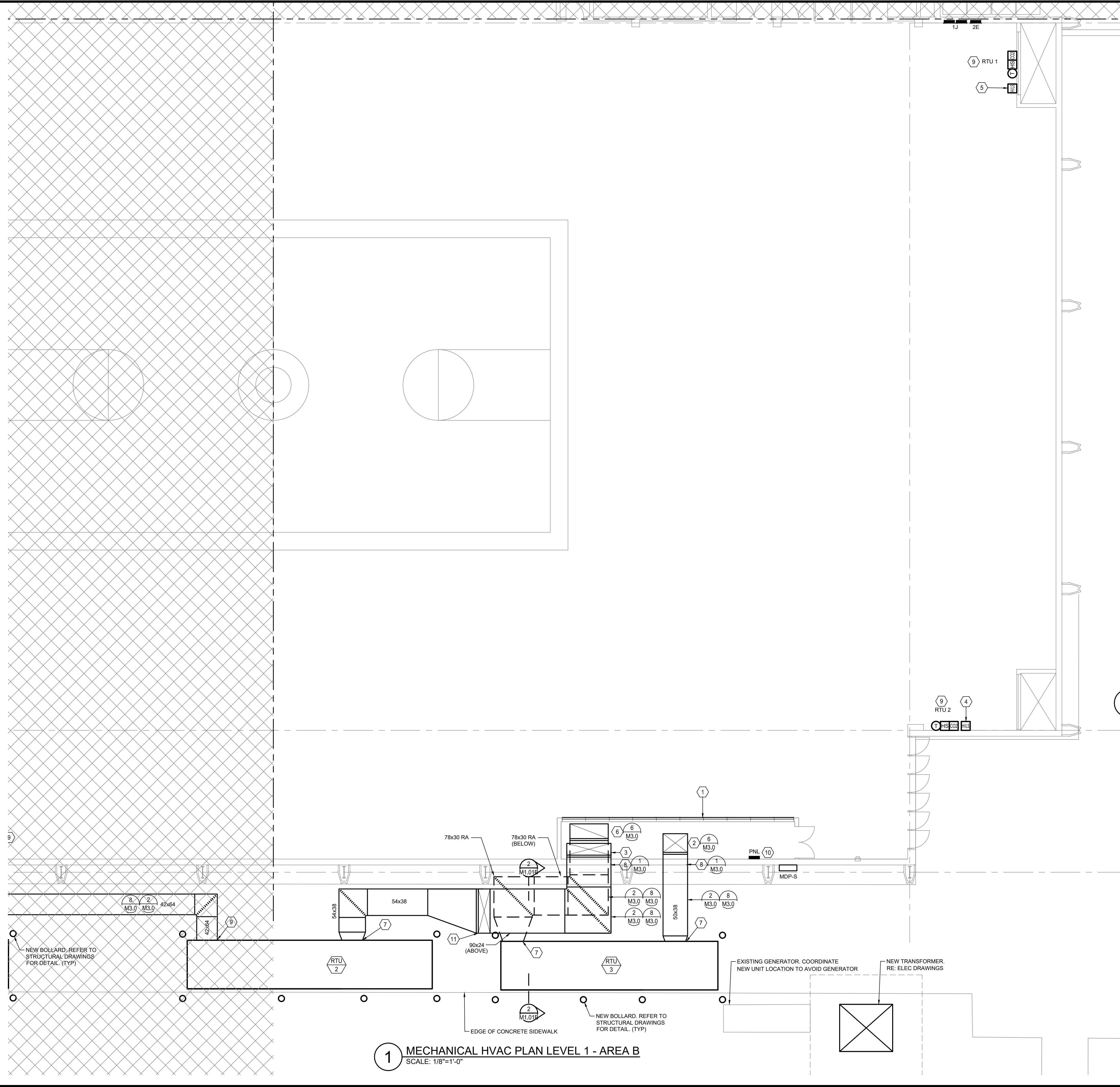
KELLEY P. CRAWFORD

MECHANICAL PLAN NOTES:

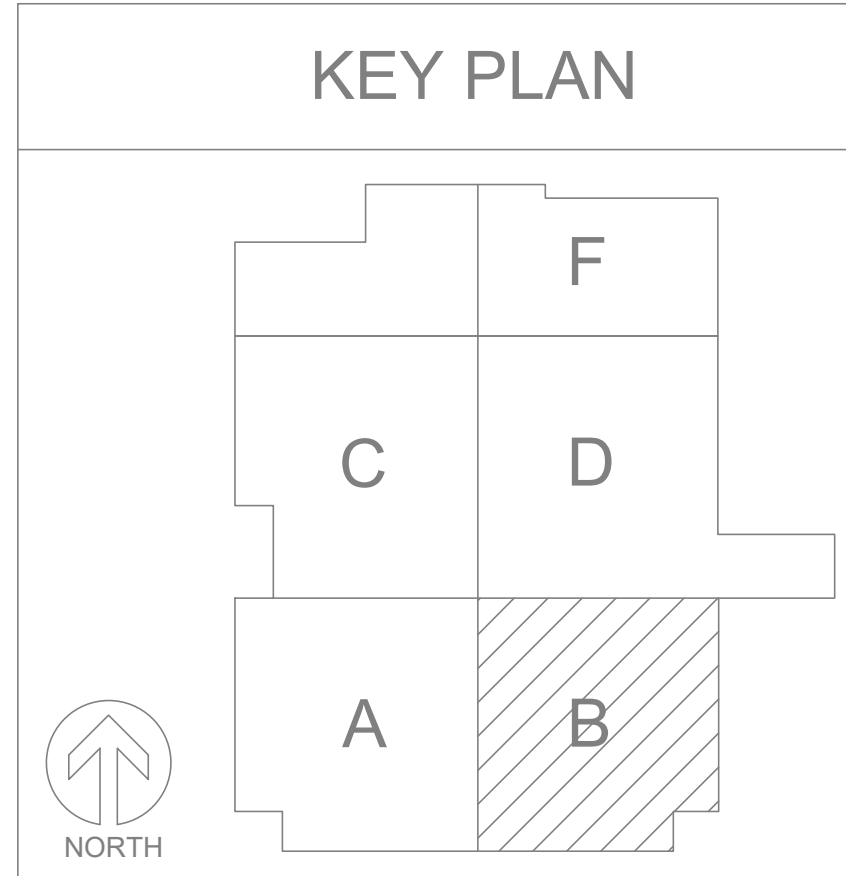
1. REUSE EXISTING 48"x34" GRILLES MOUNTED LOW IN WALL FOR RETURN AIR. VACUUM GRILLES AND WIPE THEM CLEAN OF ANY DUST OR DEBRIS.
2. 90x38 SUPPLY AIR UP WALL THRU CEILING OF STORAGE ROOM TO TRUSS SPACE. RE: M1.02B FOR CONTINUATION.
3. 90x24 SUPPLY AIR UP THRU CEILING OF STORAGE ROOM TO TRUSS SPACE. RE: M1.02B FOR CONTINUATION.
4. LOCATE HVL S 2 CONTROLLER ON WALL ADJACENT TO RTU 2 THERMOSTAT, HUMIDITY SENSOR, AND CARBON DIOXIDE SENSOR.
5. LOCATE HVL S 3 CONTROLLER ON WALL ADJACENT TO RTU 3 THERMOSTAT, HUMIDITY SENSOR, AND CARBON DIOXIDE SENSOR.
6. TURN RETURN AIR DUCT UP IN STORAGE ROOM AND ROUTE UP TO 4FT BELOW CEILING. COVER RETURN AIR OPENING IN RETURN AIR DUCT WITH 1/2" GALVANIZED STEEL BIRD SCREEN. STICK PIN 2" THICK FIBROUS BLACK DUCT LINER TO THE UNDERSIDE OF THE CEILING ABOVE RETURN DUCT FOR SOUND ABSORPTION.
7. TRANSITION FROM UNIT OPENING SIZE TO DUCT SIZE INDICATED ON PLAN. BOTTOM OF DUCT SHALL BE MINIMUM 24" ABOVE GRADE.
8. ROUTE DUCT THROUGH PERIMETER WALL INTO STORAGE ROOM. REFER TO STRUCTURAL DRAWINGS FOR EXTERIOR WALL PENETRATION REQUIREMENTS.
9. PROVIDE SURFACE MOUNTED 1" CONDUIT FOR CONTROL WIRE FROM RTU CONTROLLER TO EACH RTU SENSOR. PAINT TO MATCH ADJACENT SURFACE.
10. COORDINATE WITH DIVISION 28 CONTRACTOR TO RELOCATE EXISTING STORAGE ROOM LIGHTS AND CONDUIT AS NEEDED TO ROUTE DUCTWORK IN STORAGE ROOM.
11. OFFSET 90"x24" SUPPLY AIR DUCT UP ABOVE RETURN AIR DUCT.



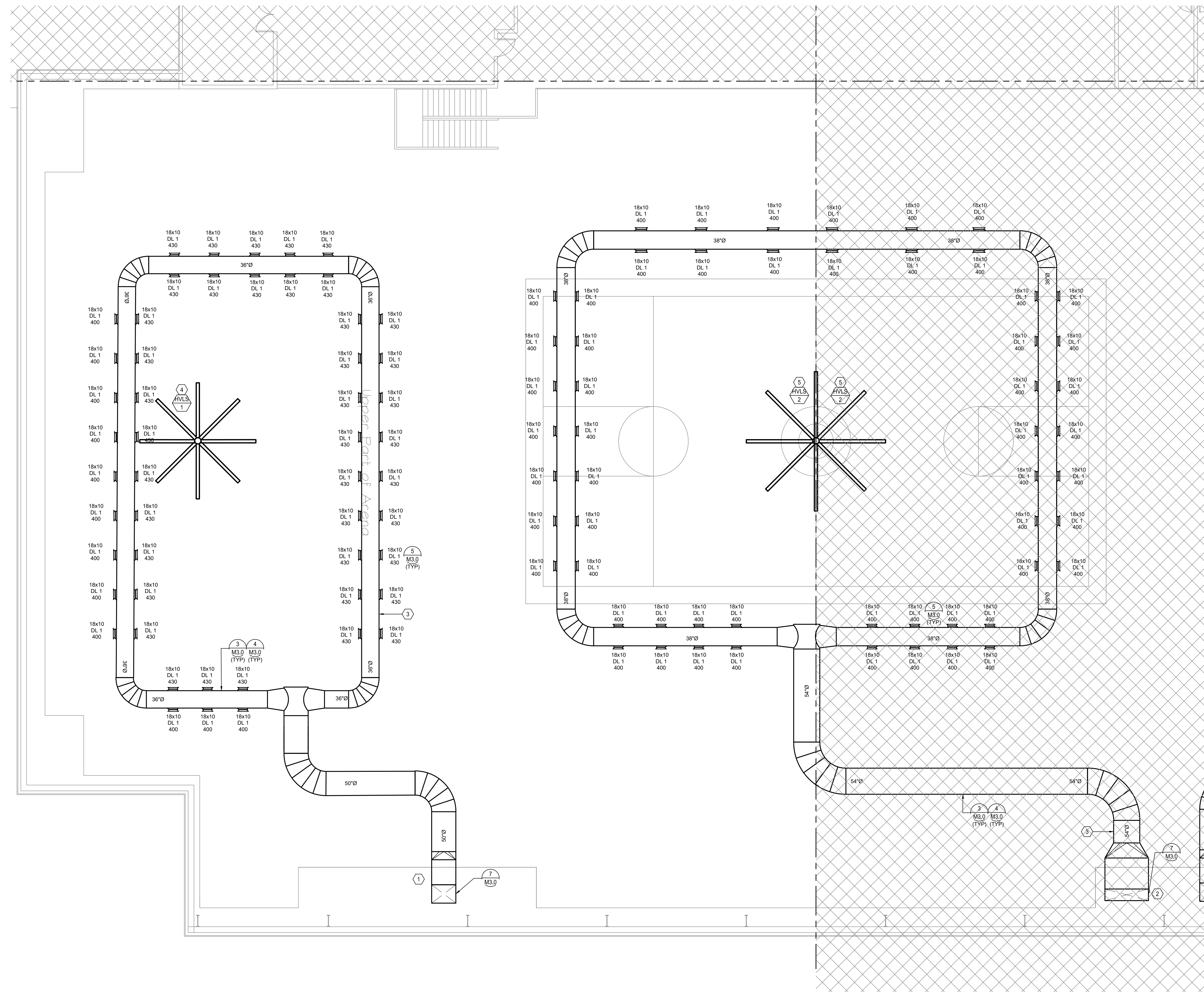
2 STACKED DUCTWORK SECTION
SCALE: 1/8"=1'-0"



1 MECHANICAL HVAC PLAN LEVEL 1 - AREA B
SCALE: 1/8"=1'-0"



KEY PLAN

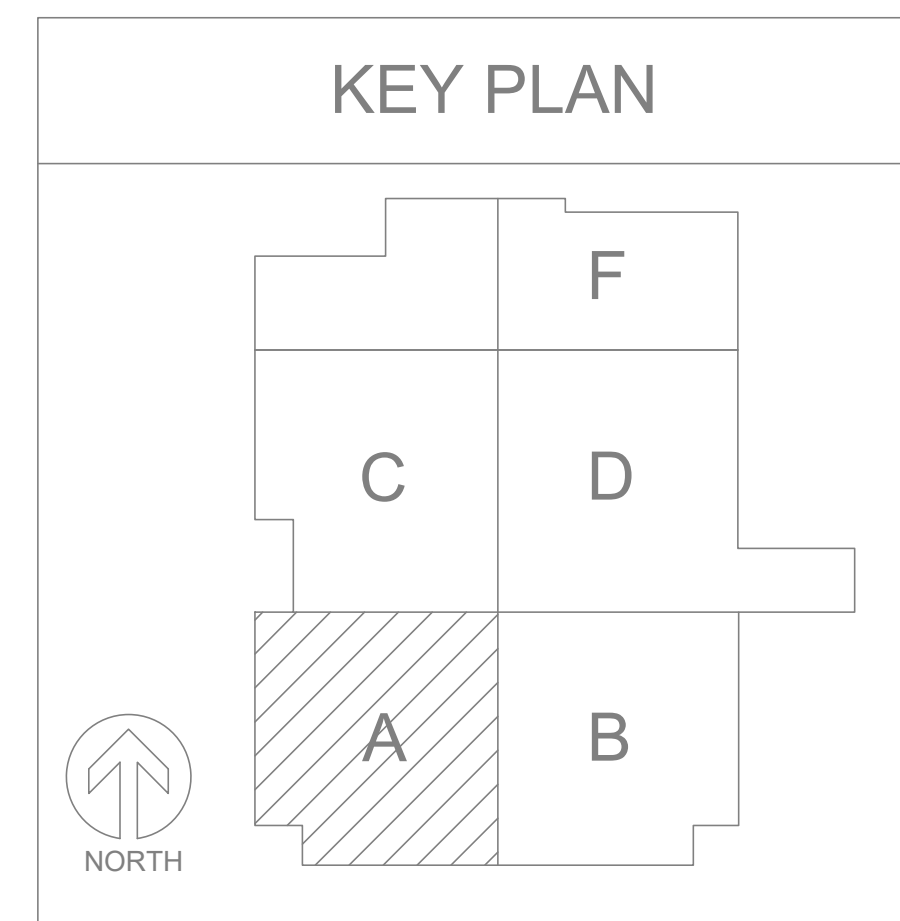


- MECHANICAL PLAN NOTES:**
1. 50"x38" UP FROM LEVEL BELOW.
 3. RUN SUPPLY DUCT LOW IN TRUSS SPACE, ABOVE LIGHT FIXTURES.
 4. SUSPEND H.V.L.S. FAN 5 FEET BELOW BOTTOM OF EXISTING TRUSS. INSTALL WITH MANUFACTURER'S MOUNTING KIT AND REFER TO IOM FOR MOUNTING INSTRUCTIONS.
 5. SUSPEND H.V.L.S. FAN 5 FEET BELOW BOTTOM OF EXISTING STRUCTURAL SUPPORT. INSTALL WITH MANUFACTURER'S MOUNTING KIT AND REFER TO IOM FOR MOUNTING INSTRUCTIONS.

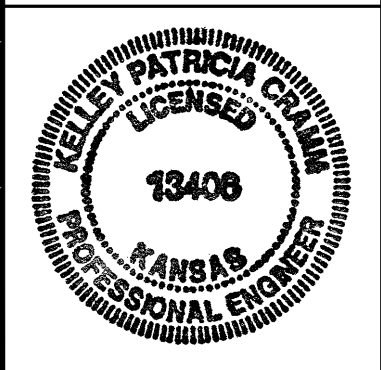
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 215001628
 PROJECT NUMBER: E-325
 10/2014

DATE: 05-28-2021 DRAWN BY: HEI



1 MECHANICAL HVAC PLAN LEVEL 2 - AREA A
 SCALE: 1/8"=1'-0"



06/02/2021

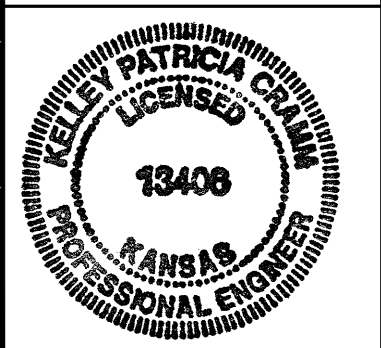
MECHANICAL HVAC PLAN

A-014285

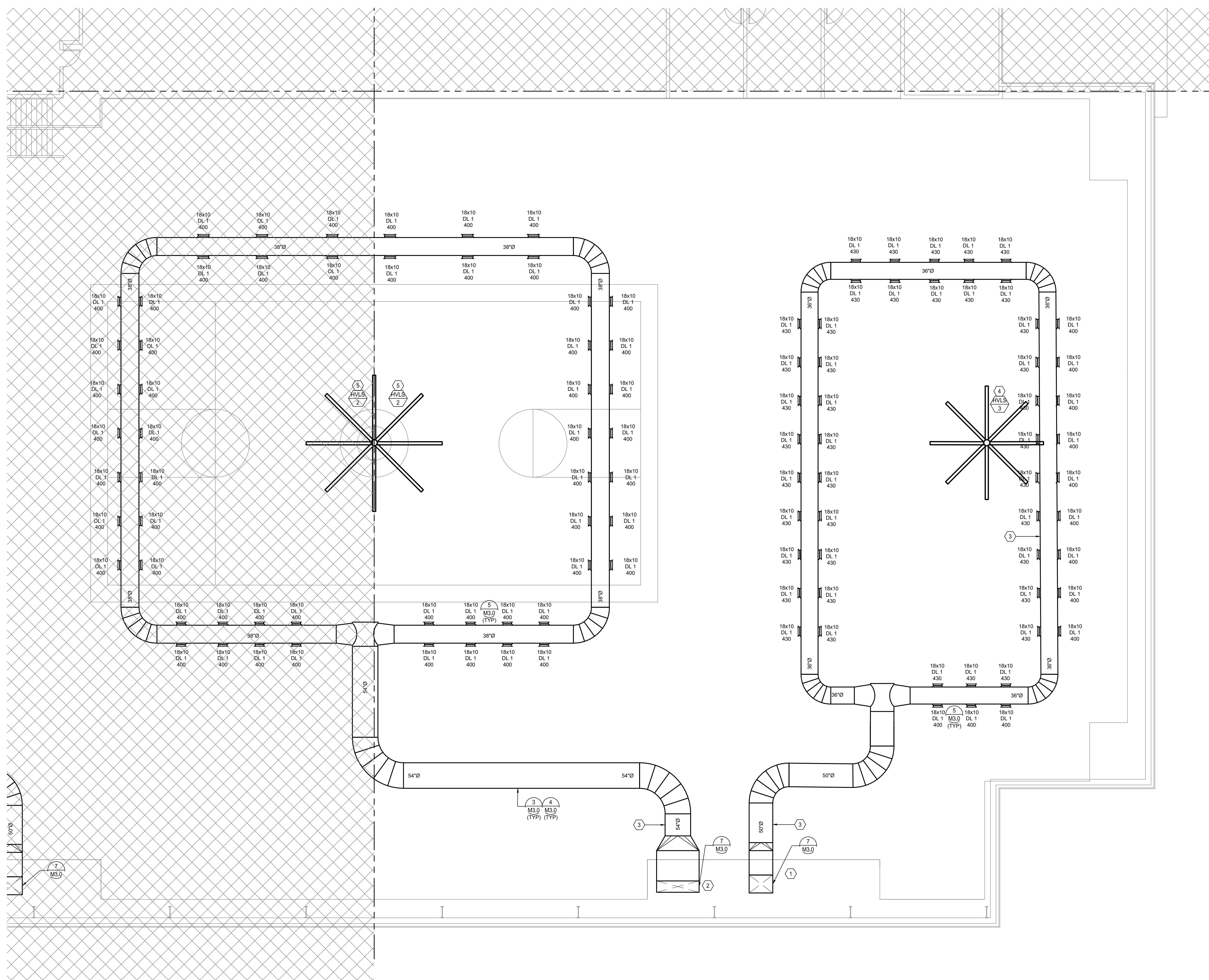
M102A

100% BID AND PERMIT

KELLEY P. GRAMM

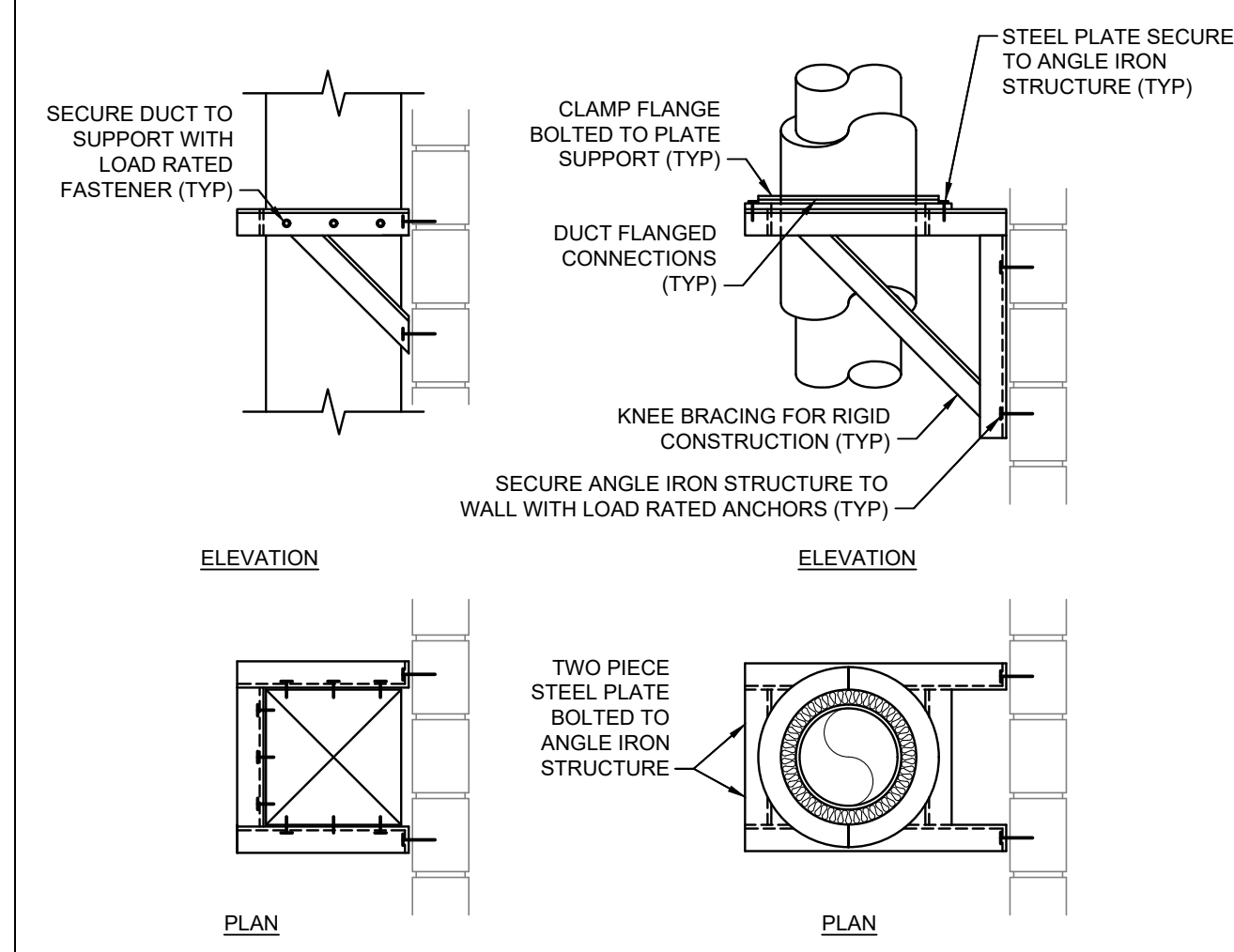


- MECHANICAL PLAN NOTES:**
- 50"x38" UP FROM LEVEL BELOW.
 - 90"x24" UP FROM LEVEL BELOW.
 - RUN SUPPLY DUCT LOW IN TRUSS SPACE, ABOVE LIGHT FIXTURES.
 - SUSPEND HVLS FAN 5 FEET BELOW BOTTOM OF EXISTING TRUSS. INSTALL WITH MANUFACTURER'S MOUNTING KIT AND REFER TO IOM FOR MOUNTING INSTRUCTIONS.
 - SUSPEND HVLS FAN 5 FEET BELOW BOTTOM OF EXISTING STRUCTURAL SUPPORT. INSTALL WITH MANUFACTURER'S MOUNTING KIT AND REFER TO IOM FOR MOUNTING INSTRUCTIONS.

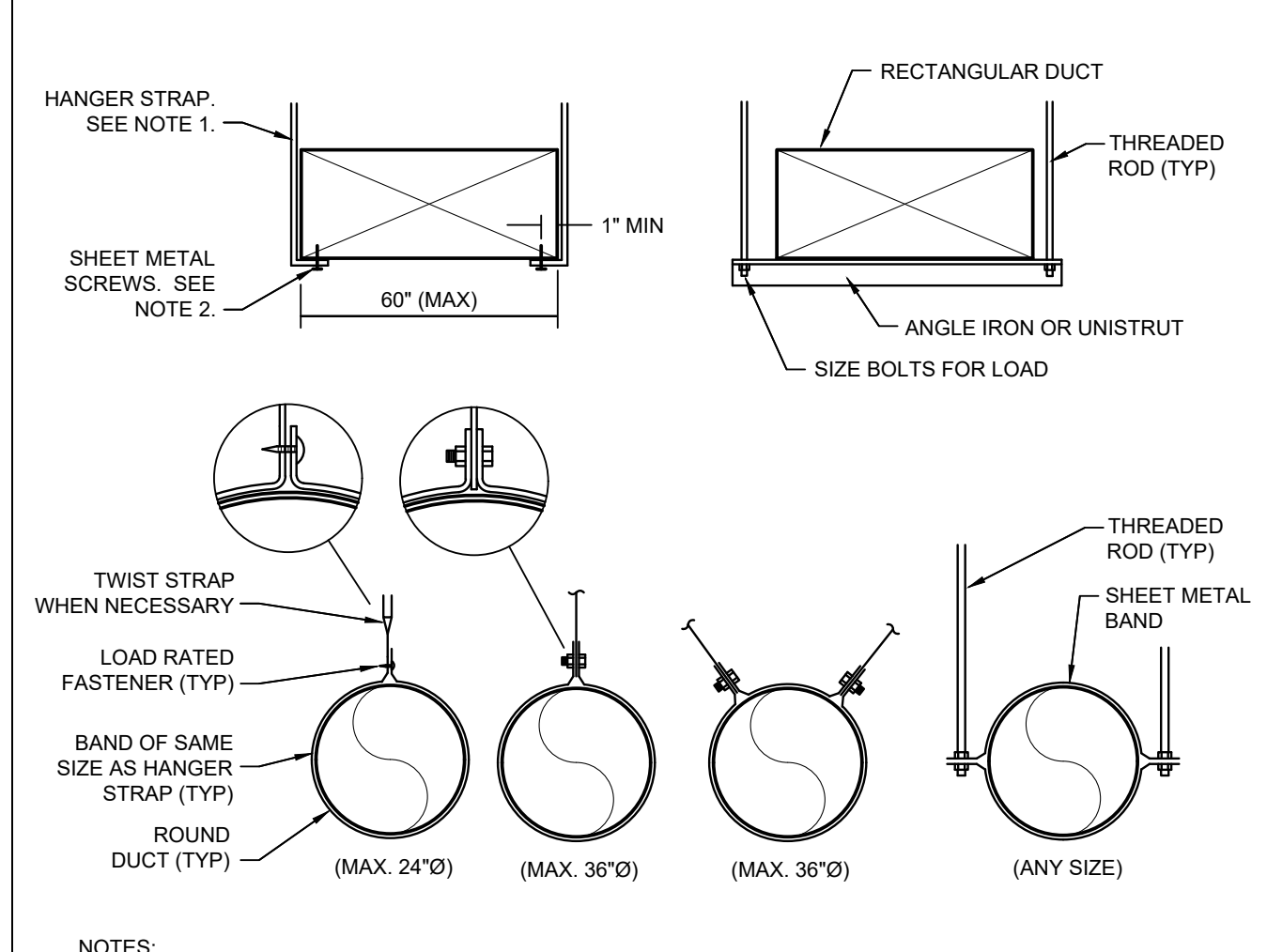


1 MECHANICAL HVAC PLAN LEVEL 2 - AREA B
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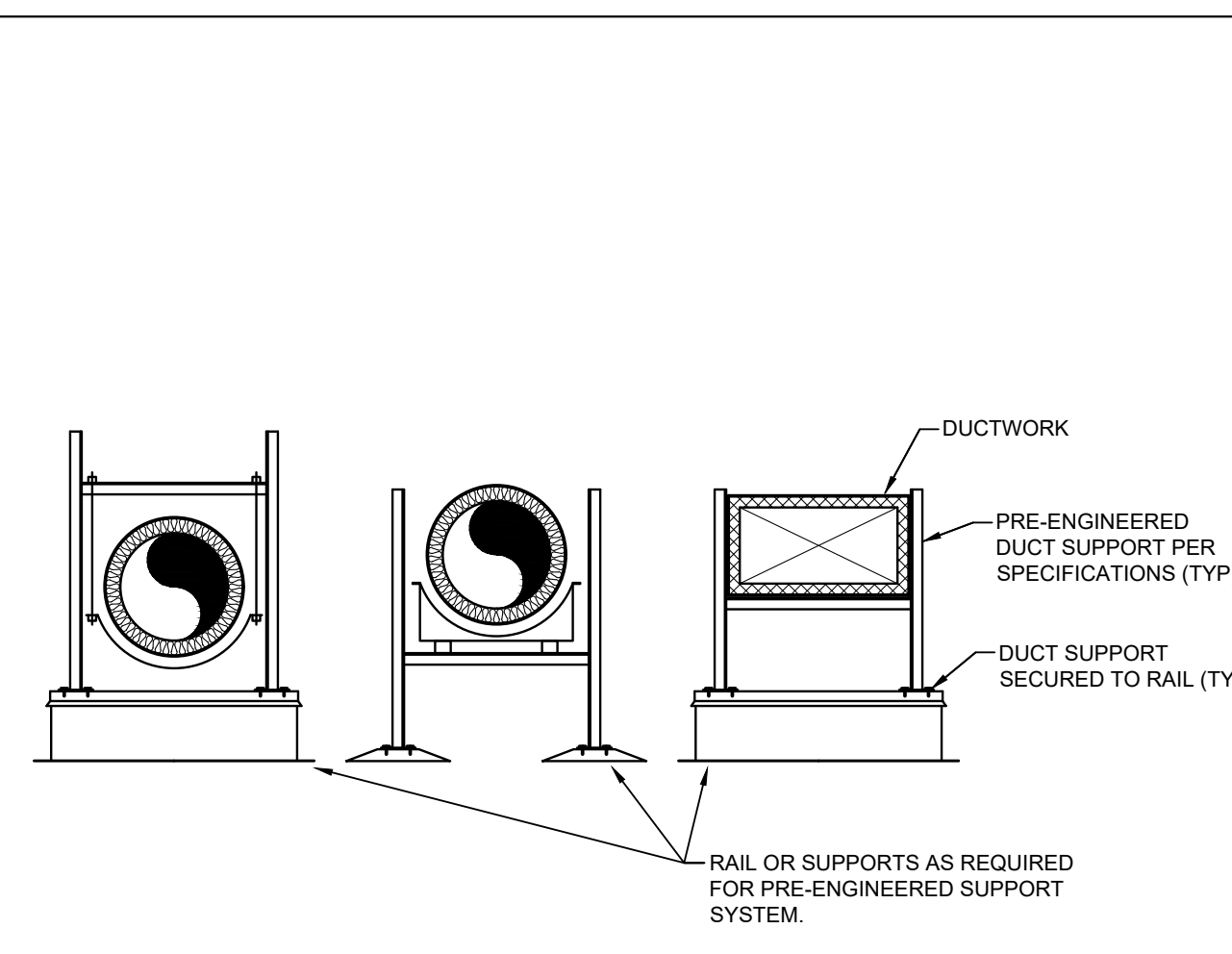
KELLEY P. CRAMM



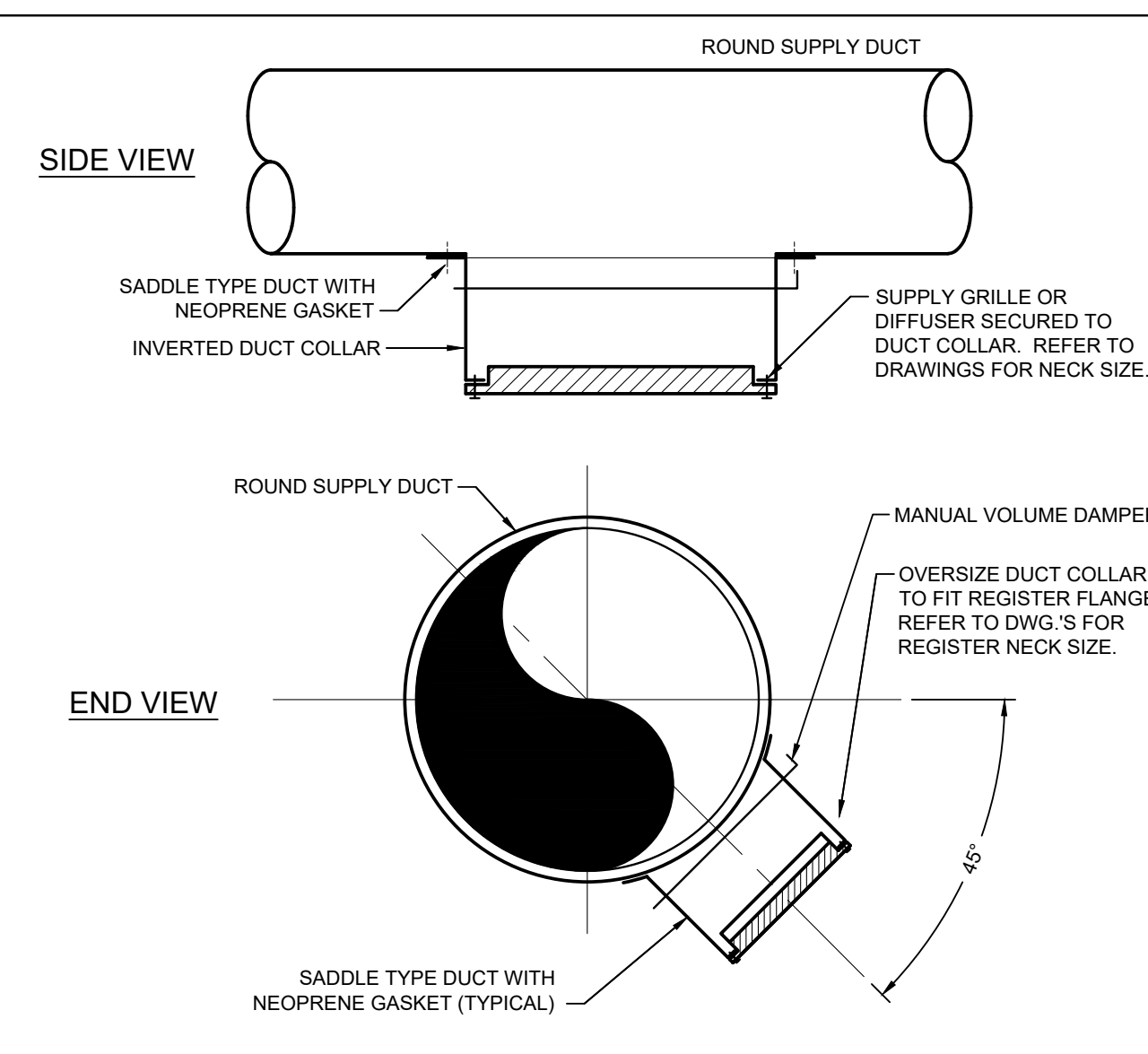
6 DUCT WALL SUPPORT DETAIL
NO SCALE



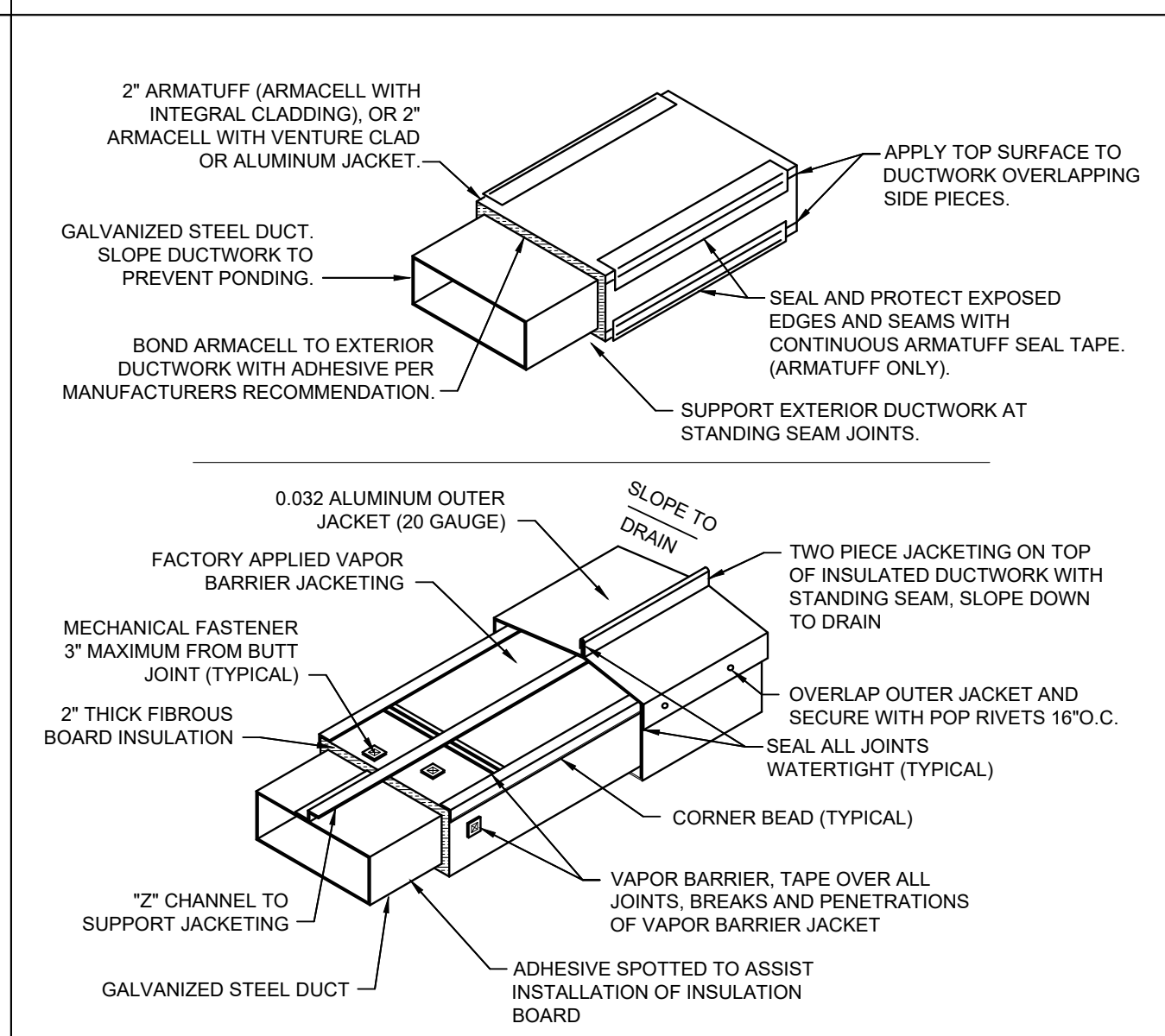
3 DUCT HANGER LOWER ATTACHMENT DETAILS
NO SCALE



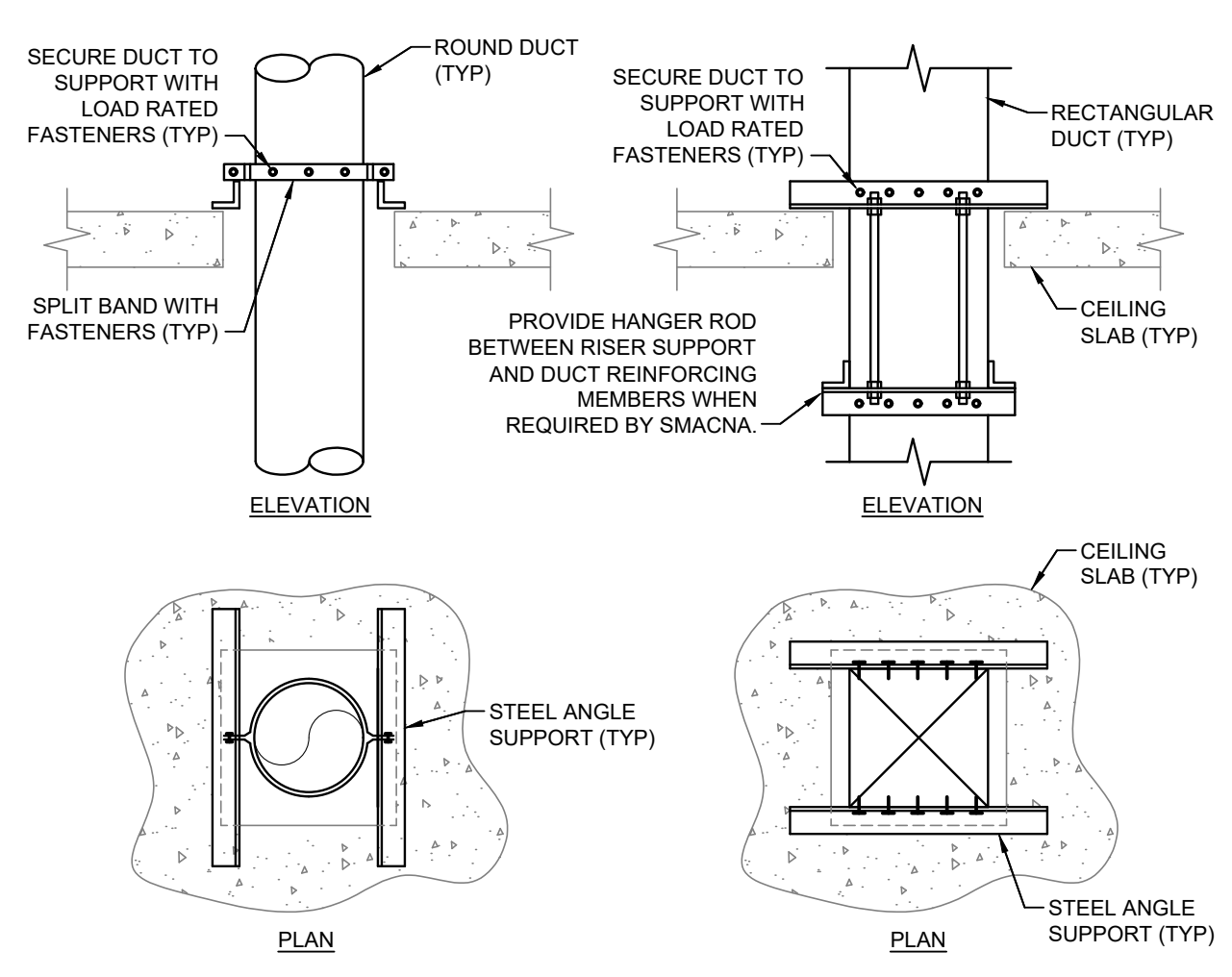
8 GRADE MOUNTED DUCT SUPPORT DETAIL
NO SCALE



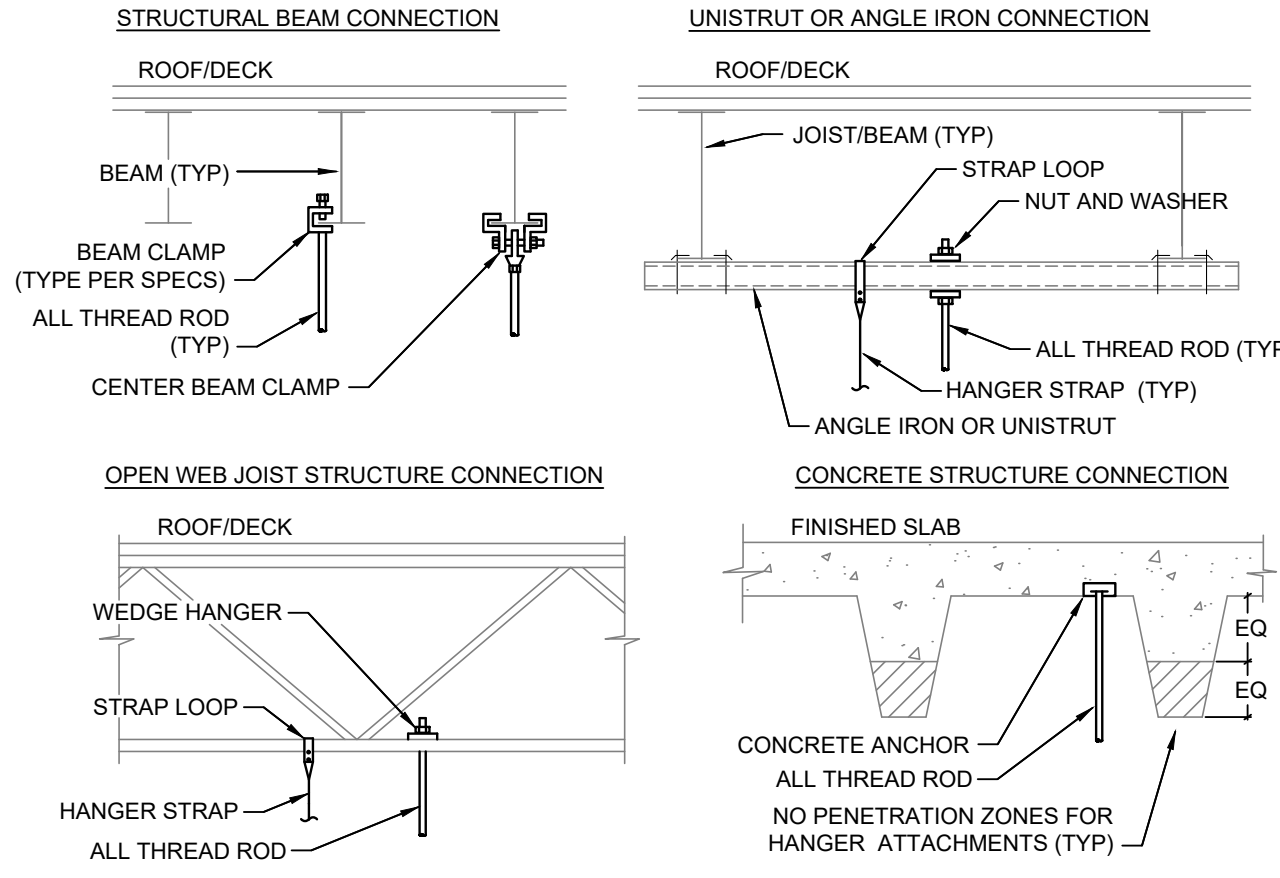
5 REGISTER MOUNTING TO ROUND DUCT DETAIL
NO SCALE



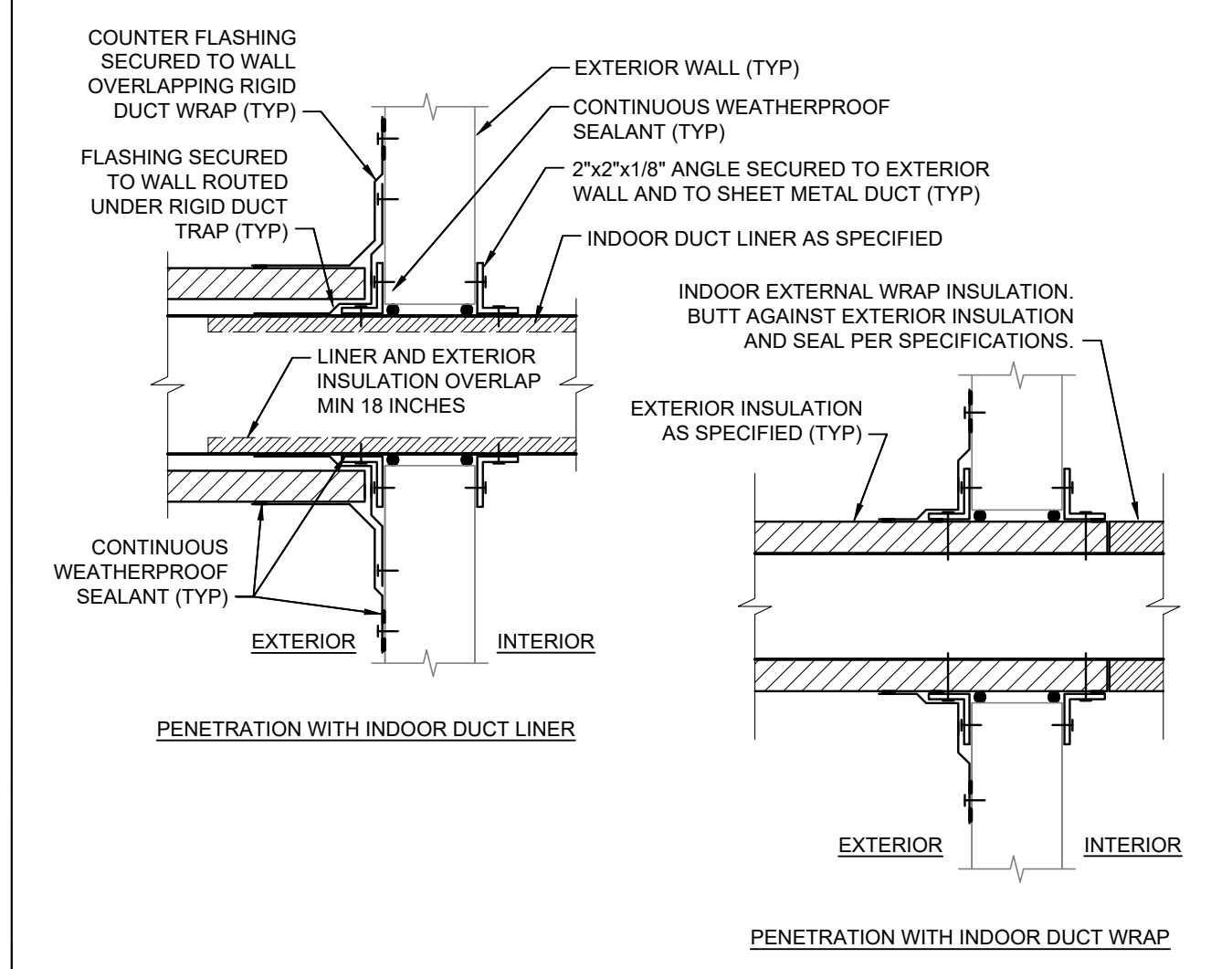
2 EXTERIOR DUCTWORK INSULATION DETAIL
NO SCALE



7 DUCT RISER SUPPORT DETAIL
NO SCALE



4 HANGER UPPER ATTACHMENT DETAILS
NO SCALE



1 DUCT EXTERIOR WALL PENETRATION DETAIL
NO SCALE

ROOFTOP UNIT SCHEDULE (DX COOLING, NATURAL GAS HEAT)

MARK	MANUFACTURER	MODEL	UNIT TYPE	SUPPLY FAN							POWER EXHAUST				RADIATED SOUND POWER (DB)						COOLING COIL						HEAT EXCHANGER						MIN O/A	ABS O/A	ELECTRICAL			WEIGHT (LBS)	NOTES								
				FAN TYPE	CFM	ESP (IN)	TSP (IN)	NO FANS	BHP	NOM HP	VFD (Y/N)	FAN TYPE	CFM	EF	NOM HP	VFD (Y/N)	63 HZ	125 HZ	250 HZ	500 HZ	1000 HZ	2000 HZ	TH (MBH)	SH (MBH)	EAT (°F DB) (°F WB)		LAT (°F DB) (°F WB)		REFR TYPE	MIN EFF (EER)	MAX VEL (FPM)	MIN OUT (MBH)			NOM INPUT (MBH)	MIN EFF (%)	EAT (°F DB)			LAT (°F DB)	MIN NO STAGES	MAX VEL (FPM)	MIN	ABS	VIPH	MCA	MOC
RTU 1	DAIKIN	RPS079D	SZVAV	AF DWDI	22,000	1	4.55	1	23.05	25.0	Y	PROP	22,000	0.2	5	Y	90	91	82	85	86	85	993.1	684.1	81.7	66.7	52.3	50.8	R410A	9.5	9.6	400	696	850	81	22	80	MOD	400	8400	3000	480/3	189.5	200	NF	12000	A,B,C,D,F,G,H,J,K,L,M,N,R,S,T,U,V,W,X,Y,Z
RTU 2	DAIKIN	RPS120D	SZVAV	AF DWDI	24,000	1	3.92	1	21.13	25.0	Y	PROP	24,000	0.2	5	Y	90	91	82	85	86	85	1136.3	775.4	81.7	66.7	52.3	50.8	R410A	9.5	9.6	400	752	1100	81	22	80	MOD	400	9100	3000	480/3	235.5	300	NF	18000	A,B,C,D,F,G,H,J,K,L,M,N,R,S,T,U,V,W,X,Y,Z
RTU 3	DAIKIN	RPS079D	SZVAV	AF DWDI	22,000	1	4.55	1	23.05	25.0	Y	PROP	22,000	0.2	5	Y	90	91	82	85	86	85	993.1	684.1	81.7	66.7	52.3	50.8	R410A	9.5	9.6	400	696	850	81	22	80	MOD	400	8400	3000	480/3	SEE NOTE Q	NF	12000	A,B,C,D,F,G,H,J,K,L,M,N,Q,R,S,T,U,V,W,X,Y,Z	

MODEL NUMBERS AND NOMINAL TONS LISTED SHALL NOT BE CONSIDERED COMPLETE AND MATERIAL SHALL NOT BE ORDERED BY MANUFACTURER, MODEL NUMBERS, OR NOMINAL TONS ONLY. REVIEW THE COMPLETE DESCRIPTION, NOTES AND SPECIFICATIONS TO DETERMINE THE EXACT MATERIAL AND A

NOTES:

- A. REFER TO SHEET M5.0 FOR ROOFTOP UNIT CONTROL DRAWING, POINTS LIST, AND SEQUENCE.
- B. EQUIPMENT SIZED FOR 100°F AMBIENT TEMPERATURE.
- C. PROVIDE 4" MERV 13, EFFICIENT PLEATED THROUGHWAY AIR FILTERS.
- D. PROVIDE VARIABLE FREQUENCY DRIVE(S) WITH INTEGRAL DISCONNECT.
- F. PROVIDE FACTORY MOUNTED VARIABLE FREQUENCY DRIVE TO FACILITATE MODULATING FAN SPEED CONTROL.
- G. PROVIDE SHAFT GROUNDING SYSTEM ON MOTOR. REFER TO MOTOR SPECIFICATION FOR ADDITIONAL INFORMATION.
- H. PROVIDE SINGLE POINT POWER CONNECTION.
- J. COORDINATE SIZE OF CONDUCTOR TERMINATION LUGS WITH CONDUCTOR SIZES SHOWN ON ELECTRICAL DRAWINGS.
- K. PROVIDE 125 VAC, 20 AMP DUPLEX CONVENIENCE RECEPTACLE PREWIRED FROM UNIT WITH A COVER UL LISTED FOR WET AND DAMPER LOCATIONS WHEN IN USE.
- L. SPECIFIED FAN ESP ACCOUNTS FOR DUCT LOSSES EXTERNAL TO UNIT.
- M. SPECIFIED FAN TSP INCLUDES EXTERNAL DUCT AND INTERNAL FILTER, COIL, AND CASING LOSSES. FILTER LOSS IS AT A MAXIMUM OF 400 FPM FACE VELOCITY.
- N. PROVIDE MOTOR HORSEPOWER TO OVERCOME INTERNAL UNIT STATIC PRESSURE DROP PLUS SPECIFIED EXTERNAL STATIC PRESSURE DROP. NOMINAL MOTOR HP SHALL BE NO LARGER THAN THE FIRST AVAILABLE NOMINAL MOTOR SIZE GREATER THAN THE REQUIRED BHP.
- Q. PROVIDE DUAL POINT POWER CONNECTION, SUPPLY FAN(S) AND CONTROLS ON ONE CIRCUIT - CIRCUIT MCA SHALL NOT EXCEED 40AMPS. REMAINING EQUIPMENT ON SECOND CIRCUIT.
- R. SCHEDULED WEIGHT IS THE MAXIMUM ALLOWABLE OPERATING WEIGHT OF THE EQUIPMENT.
- S. COOLING COIL LAT IS LEAVING AIR TEMPERATURE OF COIL.
- T. PROVIDE GUARDS TO PROTECT CONDENSER COIL FROM HAIL OR OTHER DAMAGE.
- U. PROVIDE HEATER TO MEET OR EXCEED SCHEDULED MINIMUM MBH OUTPUT. NOMINAL INPUT IS BASED ON LISTED MANUFACTURER'S STANDARD PRODUCT. COORDINATE EQUIPMENT GAS LOAD WITH PLUMBING CONTRACTOR IF DIFFERENT FROM THAT SCHEDULED. MEET MINIMUM EFFICIENCY SCHEDULED.
- V. SELECT EQUIPMENT FOR ELEVATION OF 900 FEET ABOVE SEA LEVEL.
- W. ABS. MIN. O/A IS THE ABSOLUTE MINIMUM OUTSIDE AIR CFM USING VENTILATION RESET OR DEMAND CONTROL VENTILATION.
- X. PROVIDE FULLY MODULATING HOT GAS REHEAT COIL FOR DEHUMIDIFICATION CONTROL SEQUENCE.
- Y. PROVIDE POWERED EXHAUST.
- Z. ALTERNATE MANUFACTURER SHALL NOT EXCEED SCHEDULED RADIATED SOUND LEVELS. ALTERNATE MANUFACTURER SHALL SUBMIT WITH NECESSARY UNIT MODIFICATIONS TO MEET OR IMPROVE ON SCHEDULED RADIATED SOUND LEVELS.

GRILLE, REGISTER AND DIFFUSER SCHEDULE

MARK	MANUFACTURER	SERVICE	MODEL	CONSTRUCTION TYPE	FACE TYPE	MOUNTING LOCATION	BORDER TYPE	FACE SIZE (IN)	MAX NC	MAX PRESS. DROP (IN. W.C.)	NOTES
DL 1	PRICE	SUPPLY	HCD1	STEEL	DRUM	DUCT	N/A	24X15	35	0.08	A-C

MODEL NUMBERS SHALL NOT BE CONSIDERED COMPLETE AND MATERIAL SHALL NOT BE ORDERED BY MANUFACTURER AND MODEL NUMBERS ONLY. REVIEW THE COMPLETE DESCRIPTION, NOTES AND SPECIFICATIONS TO DETERMINE THE EXACT MATERIAL AND ACCESSORIES TO BE ORDERED. THE MANUFACTURER

NOTES:

- A. FRONT BLADES PARALLEL TO SHORT DIMENSION.
- B. PROVIDE OPPOSED BLADE DAMPER ADJUSTABLE FROM FACE OF DEVICE.
- C. PROVIDE DIFFUSERS WITH NO EXPOSED MOUNTING SCREWS.

FAN SCHEDULE

MARK	MANUFACTURER	MOUNTING	MODEL	NOM HP	FAN RPM	VFD (Y/N)	ELECTRICAL			WEIGHT (LBS)	NOTES
							VIPH	DISC TYPE	STARTER TYPE		
HVLS 1	BIG ASS FANS	SUSPENDED	PFX3-20	2	78	Y	480/3	NF	VFD	290	A-F
HVLS 2	BIG ASS FANS	SUSPENDED	PFX3-24	2	65	Y	480/3	NF	VFD	350	A-F
HVLS 3	BIG ASS FANS	SUSPENDED	PFX3-20	2	78	Y	480/3	NF	VFD	290	A-F

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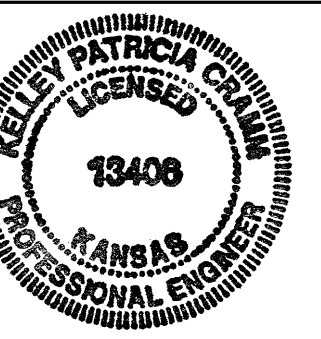
NOTES:

- A. PROVIDE WITH MANUFACTURER MOUNTING KIT AND AIRFOIL RESTRAINT SYSTEM.
- B. PROVIDE FACTORY MOUNTED DISCONNECT SWITCH.
- C. PROVIDE WITH MANUFACTURER'S FAN SPEED CONTROLLER FOR BALANCING PURPOSES.
- D. NOMINAL MOTOR HP SHALL BE NO LARGER THAN THE FIRST AVAILABLE NOMINAL MOTOR SIZE GREATER THAN THE BHP.
- E. PROVIDE STANDARD CONTROLLER WITH FAN. REFER TO DRAWINGS FOR MOUNTING LOCATIONS.
- F. PROVIDE WITH AUXILIARY CONTACTS FOR SHUTDOWN UPON NOTIFICATION FROM FIRE ALARM SYSTEM.



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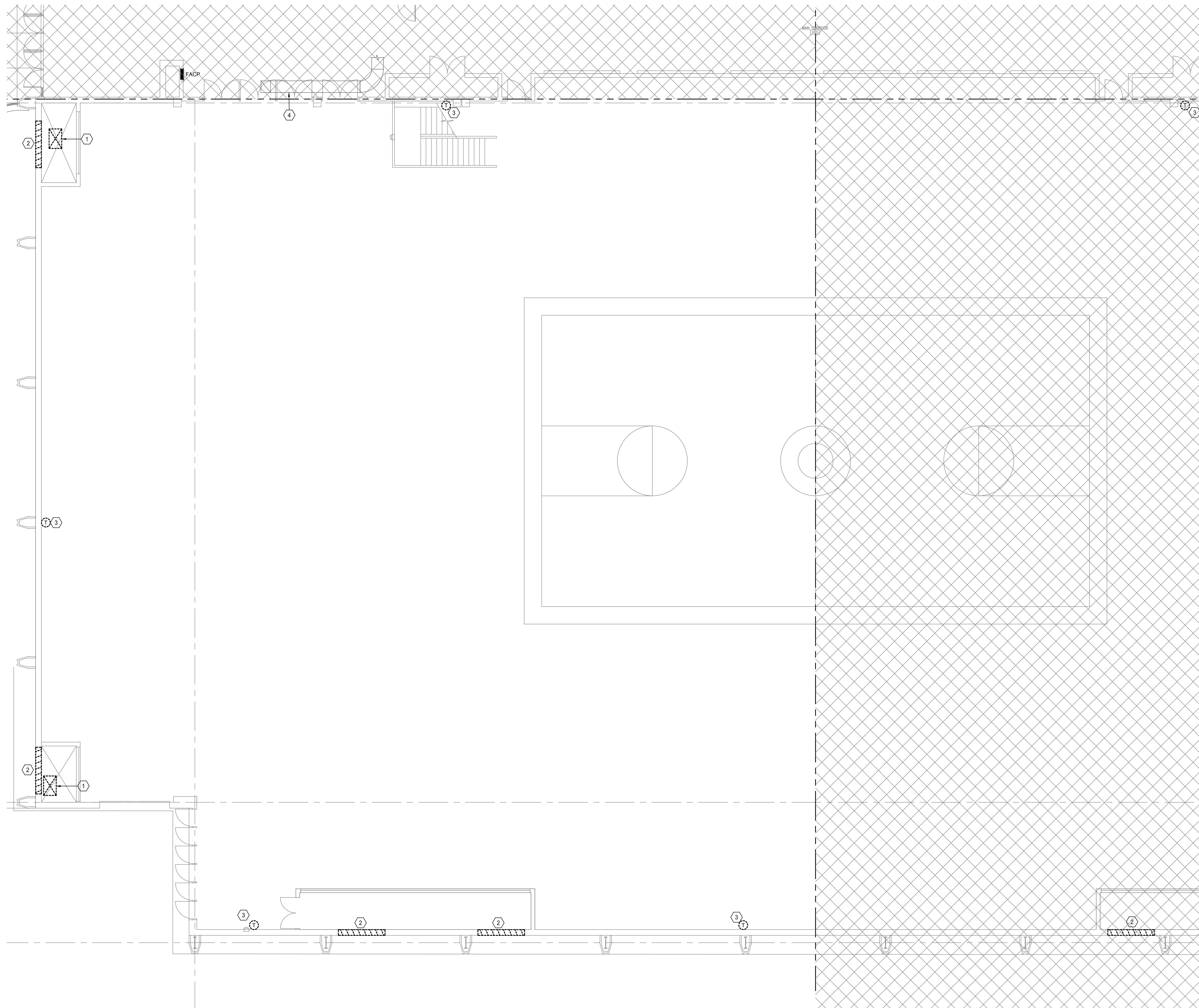
06/02/2021

MECHANICAL SCHEDULES

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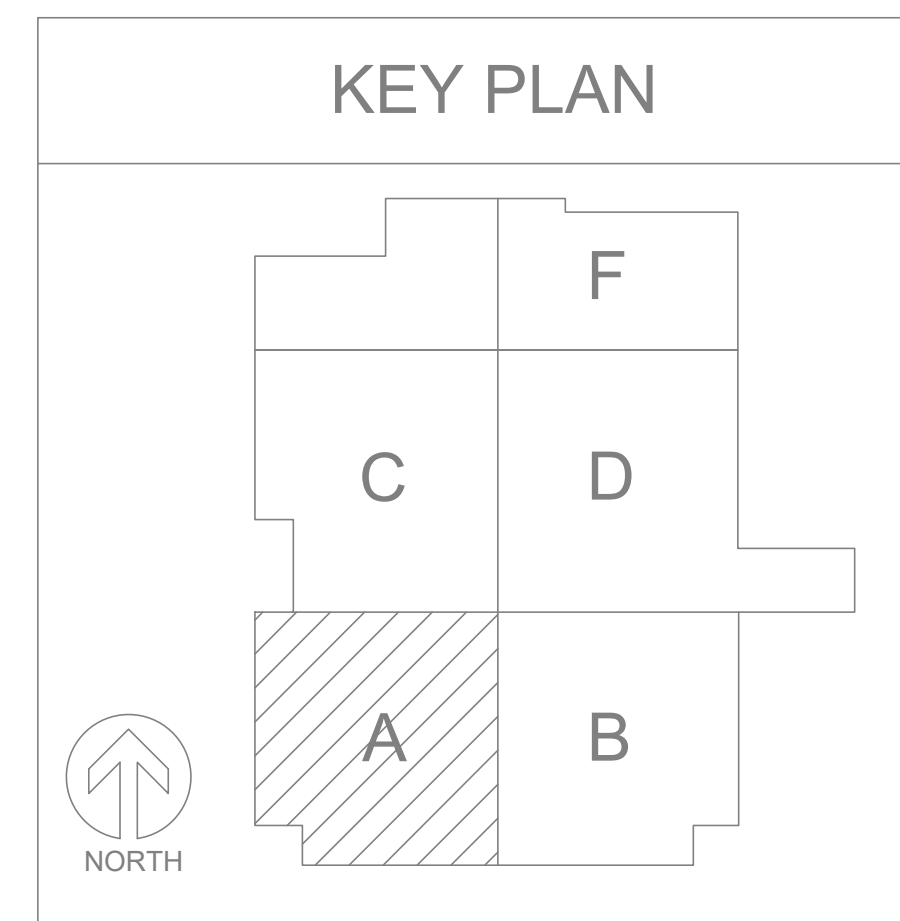
M4.00

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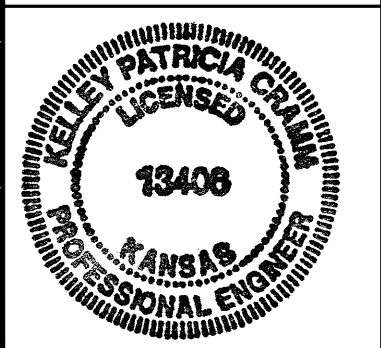
- MECHANICAL PLAN NOTES:**
1. DEMO EXISTING DUCTWORK FROM ABOVE.
 2. DEMO EXISTING LOUVER. SEAL EXISTING LOUVER OPENING.
 3. DEMO EXISTING THERMOSTAT AND WIRING BACK TO CONTROL PANEL.
 4. EXISTING DUCTWORK TO REMAIN.

1 MECHANICAL HVAC DEMOLITION PLAN LEVEL 1 - AREA A
SCALE: 1/8"=1'-0"



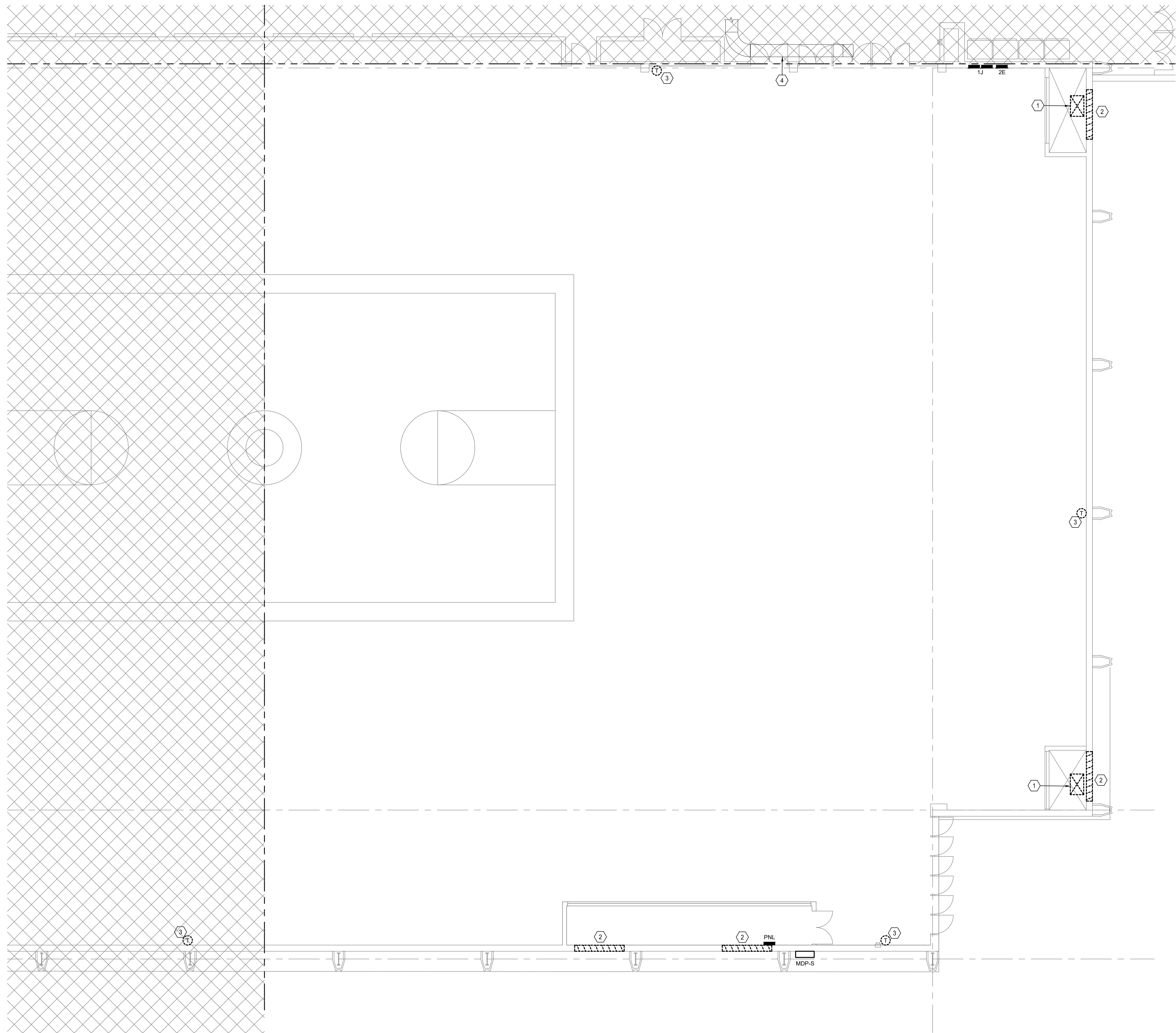
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 WWW.HENDERSONENGINEERS.COM
 215001628
 KS CORPORATE LICENSE NUMBER E-325
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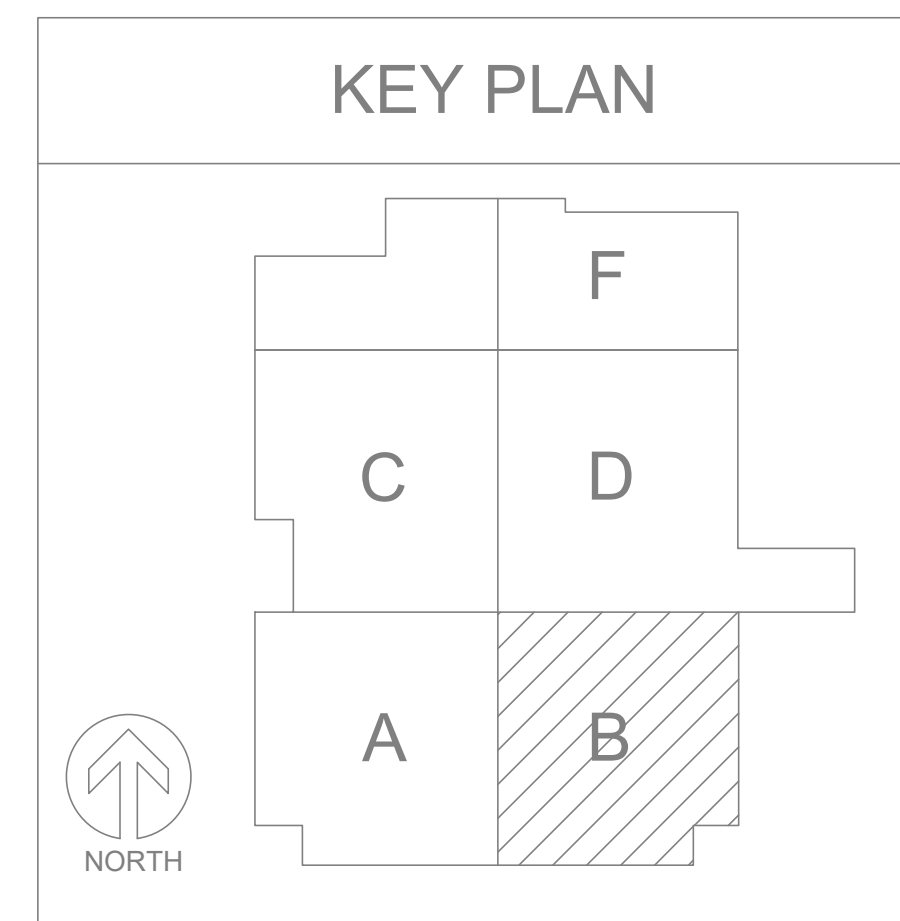
06/01/2021
MECHANICAL HVAC DEMO PLAN
A-014285
MD1.01A
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KELLEY P. CRAMM



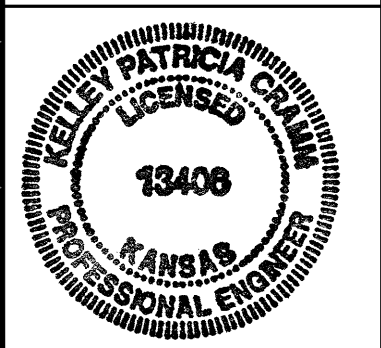
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1 MECHANICAL HVAC DEMOLITION PLAN LEVEL 1 - AREA B
SCALE: 1/8"=1'-0"



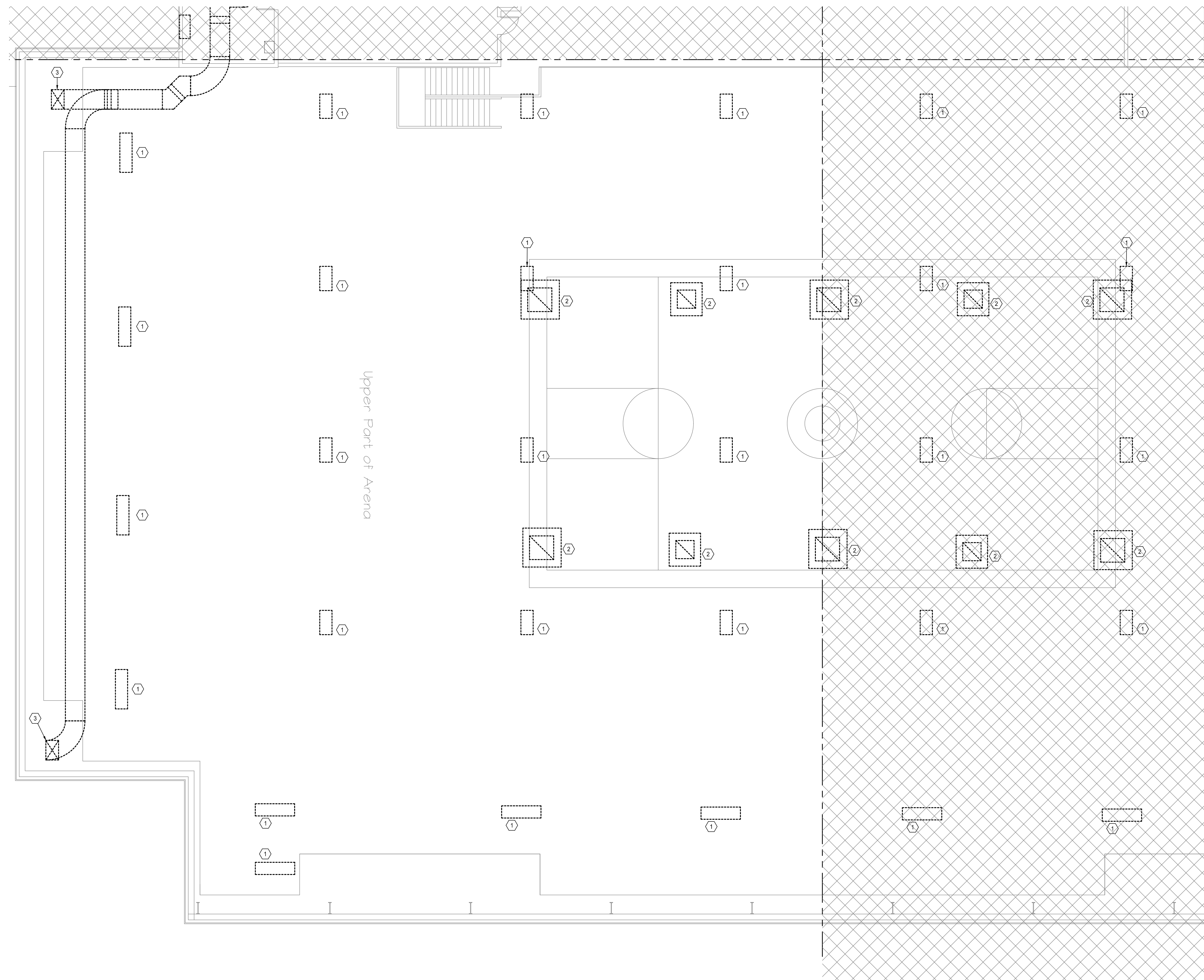
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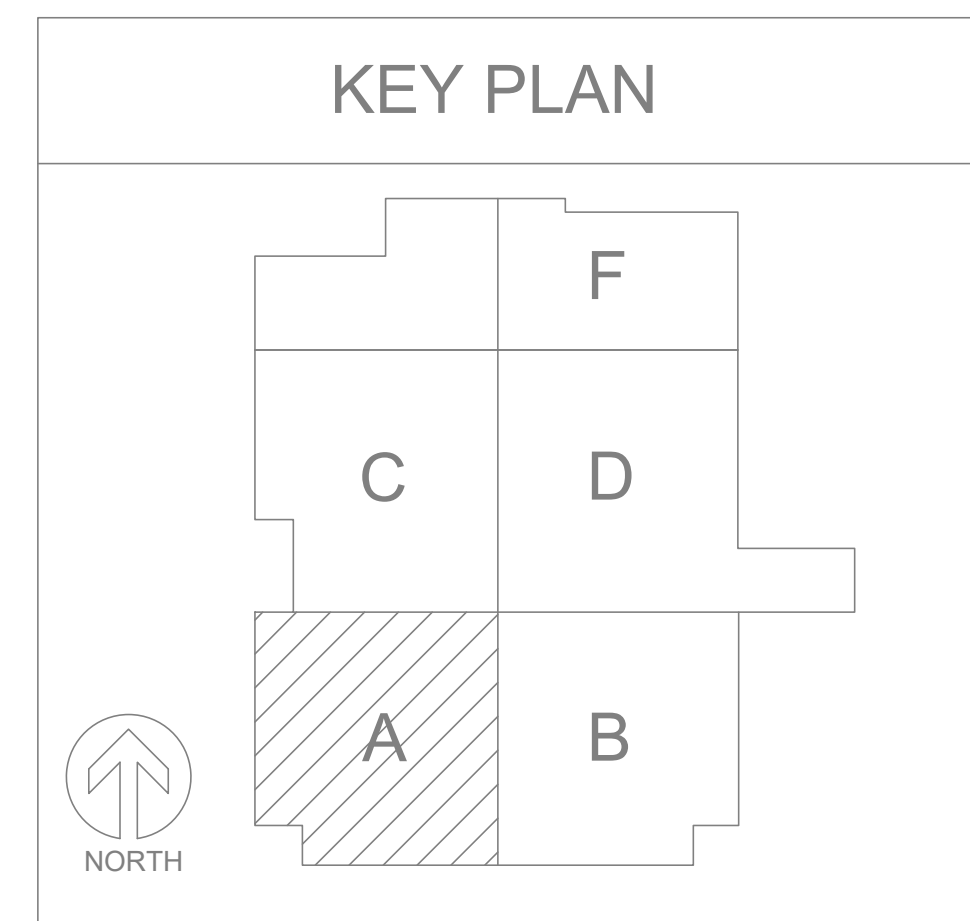
KELLEY P. CRAMM



- MECHANICAL PLAN NOTES:**
1. DEMO EXISTING GAS FIRED INFRARED HEATER. REFER TO PLUMBING DRAWINGS FOR GAS PIPE DEMOLITION REQUIREMENTS.
 2. REMOVE EXISTING ROOF MOUNTED RELIEF HOOD AND FAN. PROVIDE INSULATED SHEET METAL COVER OVER EXISTING ROOF CURB.
 3. REMOVE EXISTING DUCTWORK DOWN TO GRILLE AND BACK TO EXTENT SHOWN.

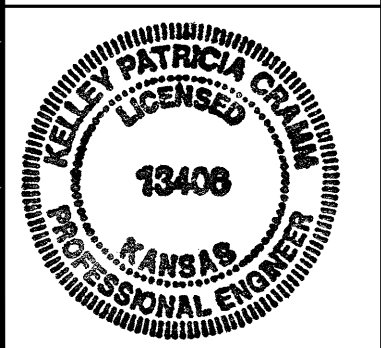
Upper Part of Arena

1 MECHANICAL HVAC DEMOLITION PLAN LEVEL 2 - AREA A
SCALE: 1/8"=1'-0"



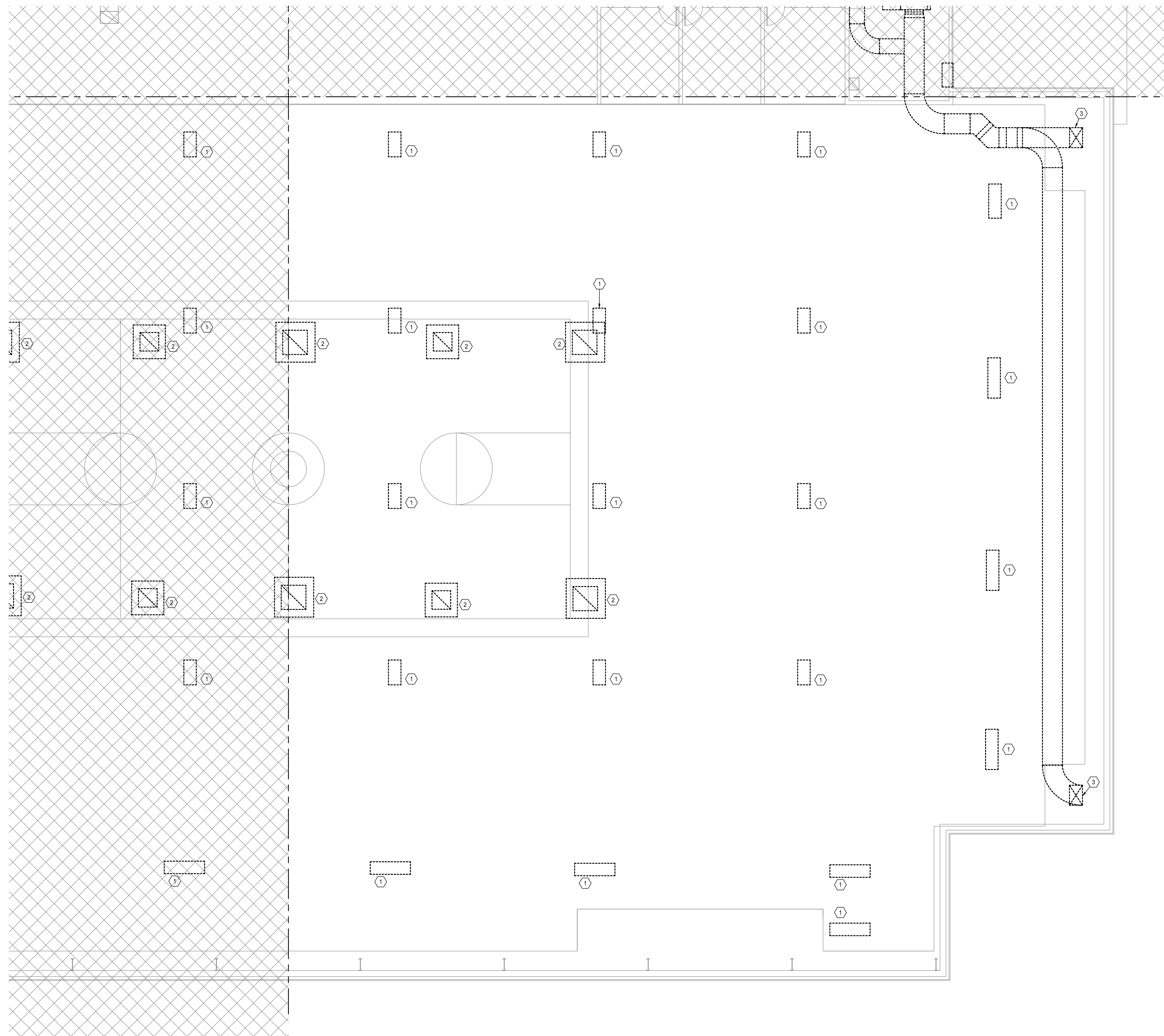
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06/01/2021
MECHANICAL HVAC DEMO PLAN
A-014285
MD1.02A
100% BID AND PERMIT

KELLEY P. CRAMM



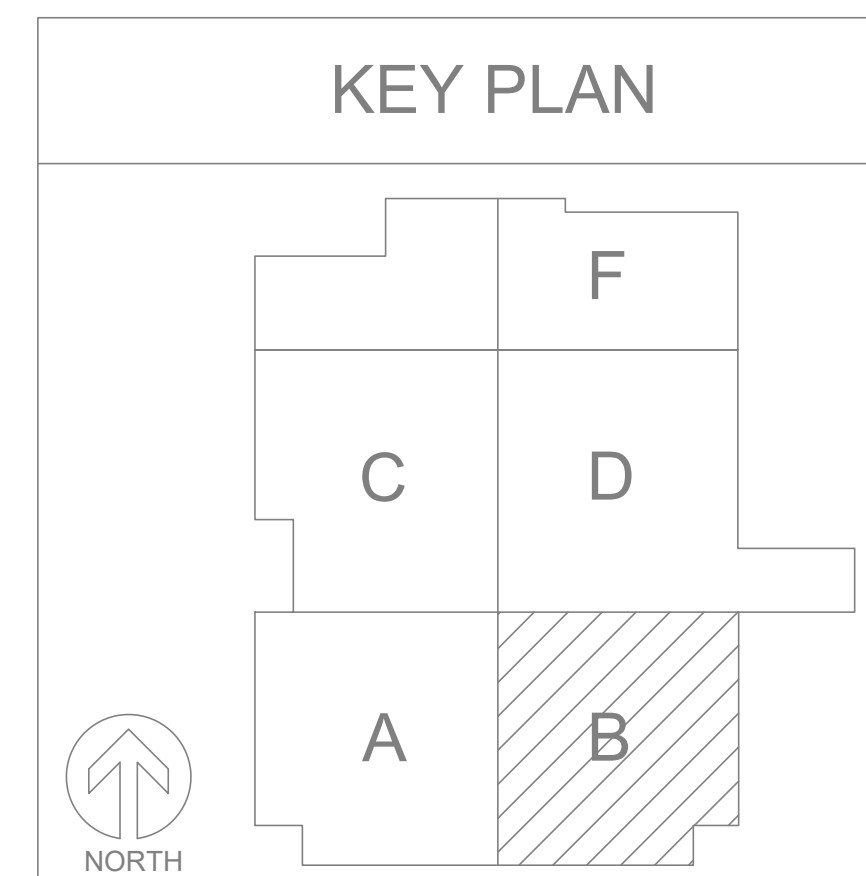
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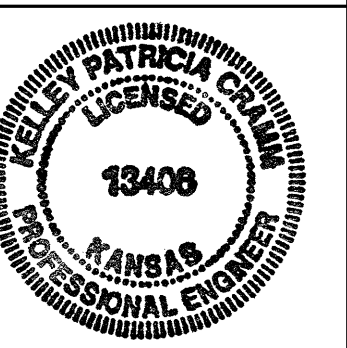
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1 MECHANICAL HVAC DEMOLITION PLAN LEVEL 2 - AREA B
 SCALE: 1/8"=1'-0"



06/01/2021

MECHANICAL HVAC DEMO PLAN

A-014285

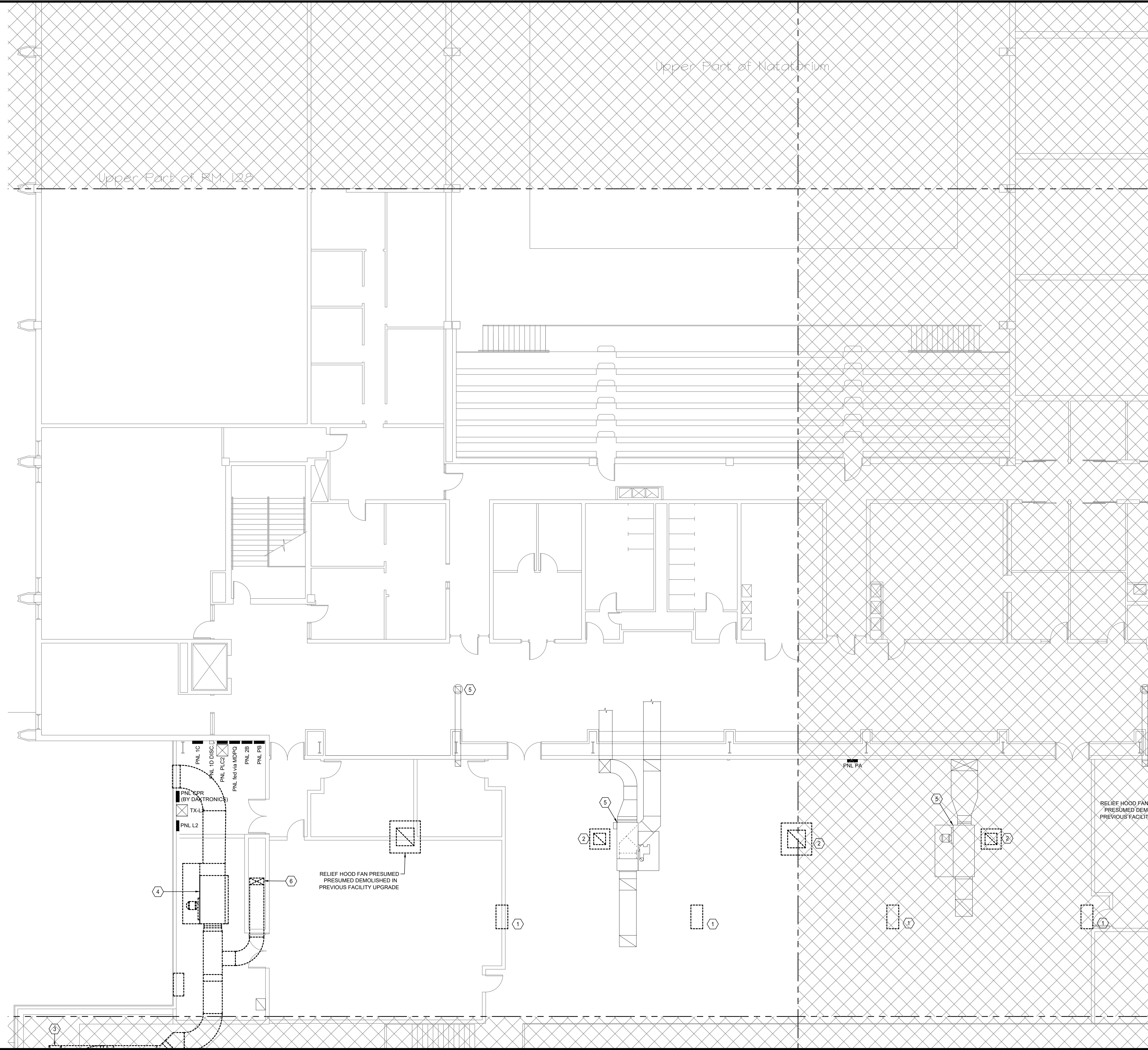
MD1.02B

100% BID AND PERMIT

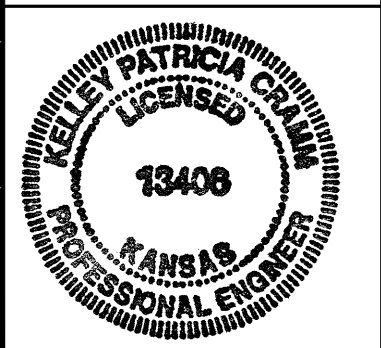
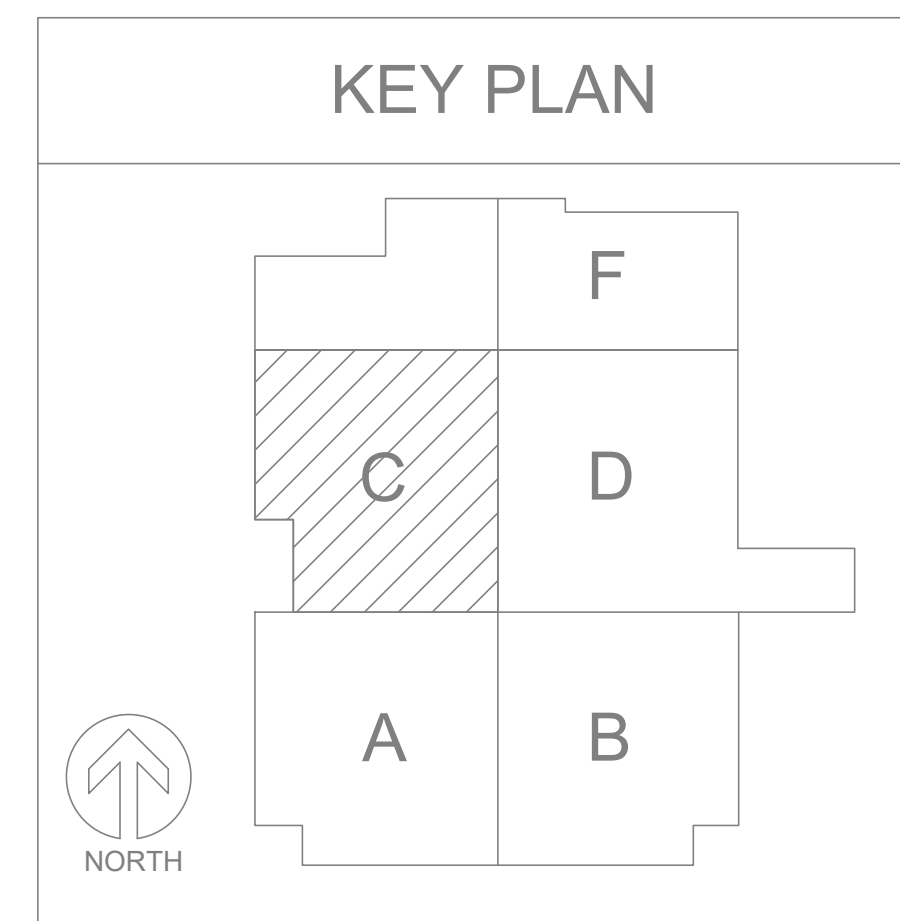
KELLEY P. CRAMM

MECHANICAL PLAN NOTES:

1. DEMO EXISTING GAS FIRED INFRARED HEATER. REFER TO PLUMBING DRAWINGS FOR GAS PIPE DEMOLITION REQUIREMENTS.
2. REMOVE EXISTING ROOF MOUNTED RELIEF HOOD AND FAN. PROVIDE INSULATED SHEET METAL COVER OVER EXISTING ROOF CURB.
3. REMOVE EXISTING DUCTWORK DOWN TO GRILLE.
4. DEMO EXISTING MAKEUP AIR UNIT AND ASSOCIATED DUCTWORK. SEAL EXISTING LOUVER OPENING USED BY MAKEUP AIR UNIT ONLY.
5. EXISTING EQUIPMENT AND DUCTWORK TO REMAIN.
6. GRILLES ASSOCIATED WITH DUCTWORK REMOVED IN PREVIOUS RENOVATION. REMOVE ABANDONED DUCTWORK.



1 MECHANICAL HVAC DEMOLITION PLAN
LEVEL 2 - AREA C
SCALE: 1/8"=1'-0"



06/01/2021
MECHANICAL HVAC DEMO PLAN
A-014285
MD1.02C
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Upper Part of Natatorium

Upper Part of RM. 114

Upper Part of RM. 115

Upper Part of RM. 116

Upper Part of RM. 110

MECHANICAL PLAN NOTES:

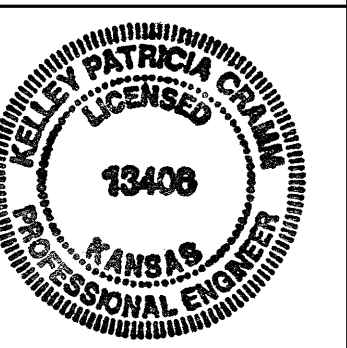
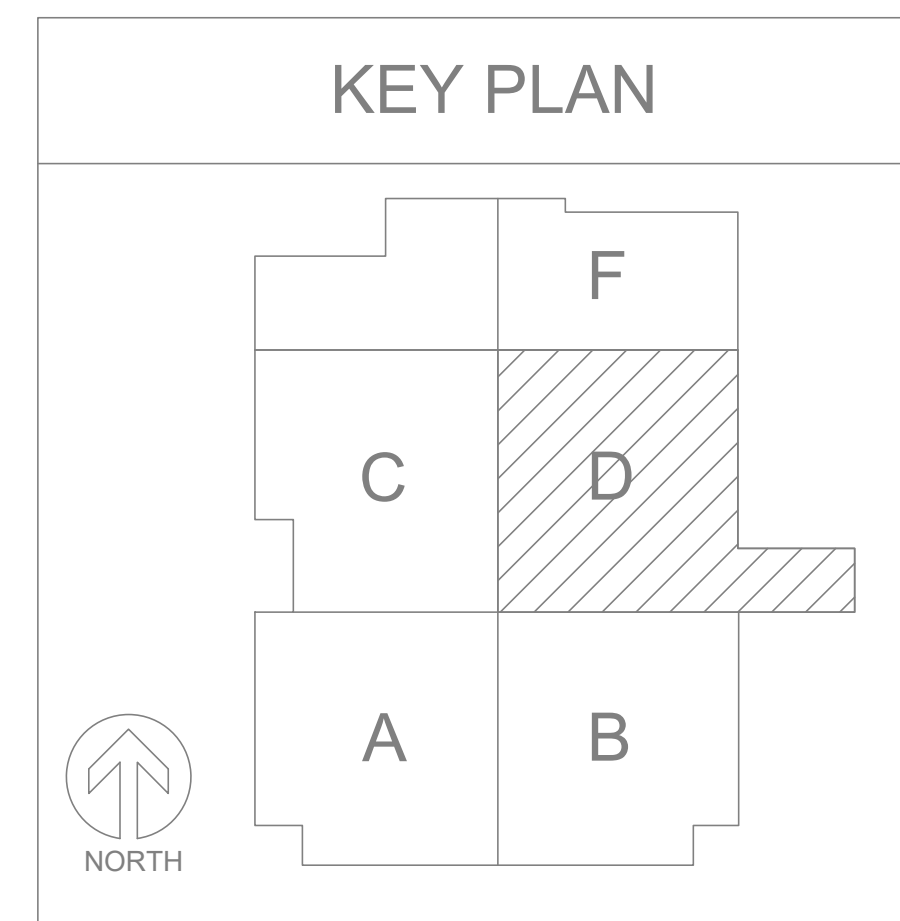
1. DEMO EXISTING GAS FIRED INFRARED HEATER. REFER TO PLUMBING DRAWINGS FOR GAS PIPE DEMOLITION REQUIREMENTS.
2. REMOVE EXISTING ROOF MOUNTED RELIEF HOOD AND FAN. PROVIDE INSULATED ROOF CURB OVER EXISTING OPENING.
3. REMOVE EXISTING DUCTWORK DOWN TO GRILLE.
4. DEMO EXISTING MAKEUP AIR UNIT AND ASSOCIATED DUCTWORK. SEAL EXISTING LOUVER OPENING USED BY MAKEUP AIR UNIT ONLY.
5. EXISTING EQUIPMENT AND DUCTWORK TO REMAIN.
6. GRILLES ASSOCIATED WITH DUCTWORK REMOVED IN PREVIOUS RENOVATION. REMOVE ABANDONED DUCTWORK.

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
 1701 S BROADWAY ST
 PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY: HEI

1 MECHANICAL HVAC DEMOLITION PLAN LEVEL 2 - AREA D
 SCALE: 1/8"=1'-0"

RELIEF HOOD FAN PRESUMED
 PRESUMED DEMOLISHED IN
 PREVIOUS FACILITY UPGRADE



06/01/2021

**MECHANICAL
 HVAC DEMO PLAN**

A-014285

MD1.02D

**100% BID
 AND PERMIT**

GENERAL ELECTRICAL DEMOLITION NOTES:

- 1. THE ELECTRICAL DRAWINGS INDICATE EXISTING ELECTRICAL ITEMS TO BE REMOVED. THE DRAWINGS ARE INTENDED TO INDICATE THE SCOPE OF WORK REQUIRED AND DO NOT INDICATE EVERY BOX, CONDUIT, OR WIRE THAT MUST BE REMOVED. CONTRACTOR SHALL INSPECT THE SITE PRIOR TO THE SUBMISSION OF A BID AND CONTRACTOR SHALL INFORM THEMSELVES OF THE CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED CONCERNING THE SITE OF THE WORK. THE OBSTACLES WHICH MAY BE ENCOUNTERED, THE DEMOLITION, AND TEMPORARY REMOVAL AND REINSTALLATION REQUIRED TO PROVIDE ACCESS TO THE WORK, AND ALL OTHER RELEVANT MATTERS CONCERNING THE WORK TO BE PERFORMED. DRAWINGS ARE TAKEN FROM THE BEST INFORMATION AVAILABLE FROM VISUAL SITE INSPECTIONS AND EXISTING DRAWINGS. CONTRACTOR SHALL VERIFY ALL EXISTING CONDITIONS AND THE INTENT OF THE WORK PRIOR TO BEGINNING WORK. CONTRACTOR SHALL REPAIR ALL DAMAGE TO EXISTING BUILDING, FIXTURES, AND FINISHES CAUSED BY CONTRACTOR DURING THE PERFORMANCE OF THE WORK. REPAIRS SHALL BE PERFORMED BY A QUALIFIED TRADESMAN AND SHALL BE COMPLETED IN A MANNER ACCEPTABLE TO THE OWNER. REMOVAL OR RELOCATION OF ANY CONDUIT, CABLES, WIRES, ETC. NOT INSTALLED IN CONDUIT, REQUIRED TO ALLOW INSTALLATION OF NEW WORK SHALL BE CONSIDERED WORK REQUIRED BY THIS CONTRACTOR WHETHER OR NOT SUCH WORK IS SHOWN ON THE DRAWINGS. CONTRACTOR SHALL VERIFY THE LOCATION OF ALL EXISTING CONDUITS SHALL INCLUDE REMOVAL OF HANGERS, SUPPORTS, AND ASSOCIATED MISCELLANEOUS MATERIALS. ALL PIPING, TUBING, CONDUITS, ETC. MADE OBSOLETE, BY WORK UNDER THIS CONTRACT, EXPOSED OR IN CONFLICT WITH NEW WORK, ARE TO BE REMOVED. REPAIR ALL HOLES IN WALLS, FLOORS, AND CEILING TO MATCH EXISTING CONDITIONS AND MAINTAIN FIRE RATING. IT SHALL BE THE RESPONSIBILITY OF THIS CONTRACTOR TO PERFORM ALL SELECTIVE DEMOLITION NECESSARY TO PERFORM THE WORK SHOWN ON THE DRAWINGS EXCEPT WHERE SPECIFICALLY NOTED OTHERWISE. ARCHITECTURAL DRAWINGS TO BE PERFORMED BY THE GENERAL CONTRACTOR SHOULD ACTUALLY BE REMOVED FROM THOSE INDICATED ON THE DRAWINGS. CONTRACTOR SHALL NOTIFY ENGINEER AND REQUEST INSTRUCTIONS. OWNER SHALL HAVE THE RIGHT TO SALVAGE ANY AND ALL MATERIALS AND EQUIPMENT OR PORTION THEREOF. ALL REMOVED EQUIPMENT MATERIALS NOT RETAINED BY THE OWNER SHALL BE CONSIDERED PROPERTY OF THE CONTRACTOR AND SHALL BE PROMPTLY REMOVED FROM THE OWNER'S PROPERTY AND LEGALLY DISPOSED OF. OWNER ASSUMES NO RESPONSIBILITY FOR CONDITION OF EQUIPMENT OR MATERIALS TO BE DEMOLISHED.

GENERAL ELECTRICAL NOTES:

- 1. THIS IS AN EXISTING FACILITY UNDERGOING RENOVATION. PRIOR TO SUBMITTING A BID, PERSONALLY EXAMINE THE SITE OF THE PROPOSED WORK AND VERIFY THE CONDITIONS WHICH INVOLVE THIS WORK. BY THE ACT OF SUBMITTING A BID, THE CONTRACTOR HAS DEEMED TO HAVE MADE REASONABLE ALLOWANCES FOR SITE EXAMINATIONS, SITE CONDITIONS, AND INCLUDE ALL COSTS IN THEIR PROPOSAL. FAILURE TO VERIFY THESE CONDITIONS WILL NOT BE CONSIDERED A BASIS FOR THE GRANTING OF ADDITIONAL COMPENSATION. READ THE SPECIFICATIONS AND REVISED DRAWINGS OF ALL DIVISIONS OF WORK. COORDINATE THIS WORK WITH ALL OTHER DIVISIONS OF WORK AND ALL SUBCONTRACTORS. PROVIDE ALL SUBCONTRACTORS WITH A COMPLETE SET OF BID DOCUMENTS. DRAWINGS ARE DIAGRAMMATIC ONLY AND REPRESENT THE GENERAL SCOPE OF WORK. REVIEW THE GENERAL NOTES, SPECIFICATIONS, AND PLANS FOR ADDITIONAL REQUIREMENTS. THE BEST INFORMATION AVAILABLE TO THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY THE ARCHITECT OF ANY CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID. THE DRAWINGS REPRESENT THE BEST INFORMATION AVAILABLE TO THE ENGINEER. ALL DIMENSIONS AND SIZES SHALL BE FIELD VERIFIED. DO NOT SCALE FROM THE DRAWINGS. SMALL DEVIATIONS SHALL BE RECONCILED DURING THE PERFORMANCE OF THE WORK. FURNISH A COPY OF INSPECTION REPORTS AND APPROVAL CERTIFICATES FROM LOCAL AND STATE INSPECTIONS TO THE ARCHITECT. DRAWINGS AND SPECIFICATIONS GOVERN, WHERE THEY EXCEED CODE REQUIREMENTS. COORDINATE ALL WORK WITH OTHER TRADES AND CONTRACTORS, INCLUDING BUT NOT LIMITED TO, REQUIREMENTS ASSOCIATED WITH NON-BASIS OF DESIGN EQUIPMENT. FIELD VERIFY EXACT LOCATIONS AND ELECTRICAL REQUIREMENTS OF ALL HVAC AND PLUMBING EQUIPMENT WITH OTHER TRADE CONTRACTORS PRIOR TO ORDERING RELATED ELECTRICAL EQUIPMENT. ROOM NAMES/NUMBERS SHOWN IN PANELBOARD SCHEDULES ARE PER ARCHITECTURAL FLOOR PLANS. CONTRACTOR SHALL PROVIDE FINALIZED PANELBOARD SCHEDULES TO ARCHITECT FOR REVIEW AND APPROVAL PRIOR TO THE START OF WORK. ROOM NAMES/NUMBERS: SEE SPECIFICATIONS FOR ADDITIONAL INFORMATION. PROVIDE A CONSTRUCTION RECORD SET OF "AS-BUILT" DOCUMENTS TO THE ARCHITECT AND ENGINEER. THE DRAWINGS AND REVISED DRAWINGS OF ALL DIVISIONS OF WORK, DEVICES, ETC. LOCATIONS CONTRARY TO THE CONSTRUCTION DOCUMENTS, REFER TO SPECIFICATIONS FOR ADDITIONAL INFORMATION. INSTALLATION SHALL COMPLY WITH LEGALLY CONSTITUTED CODES AND THE REQUIREMENTS OF THE JURISDICTION WHERE THE WORK IS TO BE PERFORMED. ALL EXPOSED CONDUIT AND BOXES WITH EXPOSED CEILING SPACES SHALL BE PAINTED TO MATCH SURROUNDING CEILING AND STRUCTURE. PROVIDE CONDUIT PARALLEL TO STRUCTURAL LINE AND IN A MANNER. WHERE DEVICES ARE MOUNTED RECESSED IN CMU WALLS, ROUTE CONDUIT CONCEALED WITHIN INTERIOR OPENINGS WITHIN CMU WALL. COORDINATE WITH GENERAL CONTRACTOR PRIOR TO CONDUIT INSTALLATION. ALL CEILING MOUNTED DEVICES INSTALLED IN ACoustICAL TILE CEILING SHALL BE CENTERED WITHIN TILE. ALL DEVICES SHOWN DIRECTLY ADJACENT TO EACH OTHER SHALL BE INSTALLED DIRECTLY ADJACENT TO EACH OTHER. ADJACENT DEVICES OF SIMILAR TYPE SHALL BE PROVIDED WITH SINGLE FACELATE WHERE FEASIBLE. ALL JUNCTION BOXES SHALL BE RIGIDLY ATTACHED TO STRUCTURE OR WALLWORK. REFER TO ARCHITECTURAL PLANS AND DETAILS FOR EXACT LOCATIONS, ALIGNMENT, AND MOUNTING OF ALL CEILING, WALL, AND FLOOR MOUNTED DEVICES. CONDUIT AND BOX ROUGH-IN FOR ADJACENT FIRE ALARM, TEMPERATURE CONTROLS, RECEPTACLES, LIGHTING CONTROL DEVICES, ETC. ON THE SAME WALL, SHALL BE PROVIDED IN A MANNER TO WHICH DEVICES ALIGN VERTICALLY ON SAME WALL. COORDINATE WITH OTHER TRADES. COORDINATE CONDUIT PENETRATIONS THROUGH SLABS WITH STRUCTURAL DOCUMENTS. CONDUITS ARE NOT TO BE ROUTED WITHIN THE COMPOSITE SLAB, WHERE SPARE CONDUIT(S) ARE INDICATED FOR FUTURE USE, PROVIDE PULL STRINGS IN CONDUIT(S) AND PROTECTIVE BUSHINGS AT OPENINGS. CAP CONDUITS WHERE LOCATED BELOW GRADE OR EXPOSED TO THE ELEMENTS. REFER TO MECHANICAL EQUIPMENT SCHEDULES FOR ELECTRICAL SCOPE OF WORK, IN ADDITION TO WORK SHOWN ON ELECTRICAL DRAWINGS. PROVIDE RECESSED CONDUIT AND OUTLET BOXES FOR ALL HVAC CONTROL LOCATIONS. PROVIDE CONDUIT FOR ALL CONTROLS WIRES LOCATED IN SPACES WITH EXPOSED CEILINGS. REFER TO MECHANICAL DOCUMENTS AND SCHEDULES FOR ALL DEVICE LOCATIONS. COORDINATE WORK WITH MECHANICAL CONTRACTOR. PROVIDE ALL MISCELLANEOUS STEEL REQUIRED FOR THE PROPER INSTALLATION OF ELECTRICAL EQUIPMENT AND SYSTEMS. PROVIDE RECESSED OUTLET BOX AND CONCEALED CONDUIT FOR ALL TELECOMMUNICATIONS OUTLET LOCATIONS. PROVIDE CONDUIT FOR ALL TELECOMMUNICATIONS WIRING LOCATED IN SPACES WITH EXPOSED CEILINGS. COORDINATE WORK WITH TELECOMMUNICATIONS PROVIDER. REFER TO SPECIFICATIONS AND DETAILS FOR APPROVED CABLE AND RACEWAY INSTALLATION. NON-COMPLIANT INSTALLATIONS OF CABLE AND RACEWAY WILL NOT BE ACCEPTED AND WILL BE BROUGHT TO COMPLIANCE AT NO COST TO THE OWNER, PRIOR TO COMPLETION OF WORK. ALL NEW AND EXISTING ELECTRICAL EQUIPMENT ALTERED UNDER THIS PROJECT SHALL BE VACUUM CLEANED OF ANY DEBRIS. ALL OPENINGS REMAINING SHALL BE SEALED WITH THE PROPER DEVICE (IE. KNOCKOUT BLANKS, BREAKER BLANKS, ETC) LISTED AND APPROVED FOR USE. NO WORK SHALL BE PERFORMED PRIOR TO REVIEW AND APPROVAL OF ALL REQUIRED SHOP DRAWINGS, PRODUCT MATERIALS, AND EQUIPMENT SUBMITTALS. ANY WORK INSTALLED PRIOR TO MEETING THESE REQUIREMENTS SHALL BE DONE SO AT THE SOLE RISK OF THIS CONTRACTOR. PROVIDE UPDATED TYPED PANEL DIRECTORIES TO REFLECT WORK PERFORMED UNDER THIS CONTRACT. PER NFPA STANDARDS, ELECTRICAL CONTRACTOR TO PROVIDE SHOP DRAWINGS, PROCEDURE, AND INSTALL ELECTRICAL DISTRIBUTION (IE. SWITCHGEAR, SWITCHBOARD, DISTRIBUTION PANELS, PANELBOARDS, AND TRANSFORMERS), ELECTRICAL DISTRIBUTION EQUIPMENT TO BE PURCHASED BY OWNER.

GENERAL ELECTRICAL POWER NOTES:

- 1. ALL CIRCUITRY SHALL BE #12 AWG IN 1/2" CONDUIT, MINIMUM, UNLESS OTHERWISE NOTED. TYPE MC CABLE MAY NOT BE USED EXCEPT FOR FISHING UP/DOWN INTERIOR WALLS. PROVIDE A SEPARATE CODE SIZED GREEN EQUIPMENT GROUNDING CONDUIT IN ALL CONDUITS AND RACEWAYS CONTAINING LINE VOLTAGE CIRCUITS. FOR ALL 20A CIRCUITS, EQUIPMENT GROUNDING CONDUCTOR SHALL MATCH PHASE CONDUCTOR SIZE. FOR CIRCUITS UPSIZED DUE TO VOLTAGE DROP, INCREASE EQUIPMENT GROUNDING CONDUCTOR SIZE PER NEC 2017 120.138. PROVIDE A NEUTRAL CONDUCTOR TO THREE-PHASE EQUIPMENT WHEREVER REQUIRED. GROUND AND NEUTRAL CONDUCTORS SHALL NOT BE SHARED UNLESS SPECIFICALLY NOTED ON DRAWINGS. REFER TO VARIABLE FREQUENCY DRIVE (VFD) INSTALLATION INSTRUCTIONS FOR POWER AND CONTROL WIRING REQUIREMENTS. PVC CONDUIT SHALL NOT BE USED FOR VFD WIRING. PROVIDE SPECIAL POWER VFD SHIELDED CABLE OR INDIVIDUAL STEEL CONDUIT TUBING WITH POWER CONDUCTORS AND GROUNDING CONDUCTOR TO EACH MOTOR. CONTROL WIRING SHALL BE ROUTED IN A SEPARATE CONDUIT AND SEPARATED FROM MOTOR WIRING BY A MINIMUM OF 3 FEET PER MANUFACTURER'S INSTRUCTION. ALL GFCI PROTECTED CIRCUITS SHALL HAVE INDIVIDUAL AND DEDICATED NEUTRALS. VERIFY REQUIREMENTS OF ALL MECHANICAL EQUIPMENT WITH SHOP DRAWING SUBMITTALS. NOTIFY ENGINEER OF ANY CONFLICTS BETWEEN SUBMITTALS AND ELECTRICAL DRAWINGS.

ELECTRICAL SYMBOLS

THIS IS A MASTER LEGEND AND NOT ALL SYMBOLS OR ABBREVIATIONS ARE USED.

STANDARD MOUNTING HEIGHTS table with columns for item, description, and height. Includes items like Audible Appliances, Alarms, Fire Alarm Panels, etc.

ABBREVIATIONS table with columns for symbol, description, and manufacturer. Includes items like AF (Ampere Fuse Size), MFR (Manufacturer), etc.

CONDUIT TICK MARK LEGEND table with columns for tick mark symbol and description. Includes items like Switched Hot (Phase) Conductors, Neutral, etc.

BRANCH CIRCUIT CONDUCTOR TABLE table with columns for # of poles, hot (phase), neutral (grounded), and grounding. Includes items like 1P, 2P, 3P.

LINETYPE LEGEND table with columns for linetype symbol and description. Includes items like Existing, Demolish, New, Future.

FIRE ALARM GENERAL NOTES: 1. PRIOR TO SUBMITTING BID, VISIT THE JOB SITE AND BECOME FULLY ACQUAINTED WITH THE EXISTING CONDITIONS OF THE PROJECT. REVIEW THE GENERAL NOTES, SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS WHICH MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY ARCHITECT, ENGINEER AND/OR OWNER OF CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID. SYSTEM DESIGN, INSTALLATION AND MATERIALS SHALL BE IN ACCORDANCE WITH APPLICABLE NFPA STANDARDS. SYSTEM SHALL ALSO MEET ALL APPLICABLE BUILDING CODES, FIRE CODES AND THE REQUIREMENTS OF THE AUTHORITY HAVING JURISDICTION AND INSURANCE CARRIER. VERIFY REQUIREMENTS PRIOR TO BID SUBMITTAL.

ANNOTATION table with columns for symbol, description, and height. Includes items like Mechanical or Fire Protection Plan Note Callout, Plumbing Plan Note Callout, etc.

CIRCUITING & WIRING table with columns for symbol, description, and notes. Includes items like Homerun to Panelboard, Circuit Continuation, Conduit Concealed, etc.

CONDUCTOR TICK MARK LEGEND table with columns for tick mark symbol and description. Includes items like Switched Hot (Phase) Conductors, Neutral, etc.

BRANCH CIRCUIT CONDUCTOR TABLE table with columns for # of poles, hot (phase), neutral (grounded), and grounding. Includes items like 1P, 2P, 3P.

A COMPLETE AND OPERATIONAL SYSTEM AS INDICATED IN THE DRAWINGS AND SPECIFICATIONS. WHERE EXISTING SYSTEMS ARE PRESENT, CONTRACTOR SHALL MODIFY, RELOCATE AND/OR PROVIDE ADDITIONAL EQUIPMENT AS REQUIRED FOR SCOPE OF WORK AS REQUIRED FOR A COMPLETE AND OPERATIONAL SYSTEM.

ADJACENT AREAS OR AS INDICATED ON THE ARCHITECTURAL DRAWINGS. PERFORM ALL WORK ACCORDING TO THE PHASING SCHEDULE FOR THIS PROJECT. PROVIDE ALL TEMPORARY DESIGN AND/OR CONFIGURATIONS THAT MEET APPLICABLE CODE REQUIREMENTS AS NECESSARY TO CONFORM TO THE PROJECT.

LIGHTING table with columns for symbol, description, and notes. Includes items like Light Fixture, Emergency Light Fixture, Night Light, etc.

POWER EQUIPMENT table with columns for symbol, description, and notes. Includes items like Electrical Panelboard, Electrical Cabinet, Transformer, etc.

BOXES, LIGHTING CONTROL & WIRING DEVICES table with columns for symbol, description, and notes. Includes items like Switch, Circuit Breaker, Receptacle, etc.

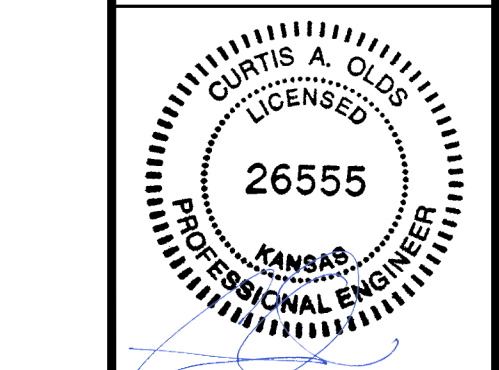
SYMBOL DEMONSTRATED WITH DUPLEX RECEPTACLE, WHEN USED IN COMBINATION WITH OTHER DEVICES MEANING IS SIMILAR FOR THOSE DEVICE TYPES. REFER TO LIGHTING CONTROL DEVICE SCHEDULE FOR MORE INFORMATION.

ELECTRICAL ONE-LINE & RISER DIAGRAM table with columns for symbol, description, and notes. Includes items like Switch, Circuit Breaker, Receptacle, etc.

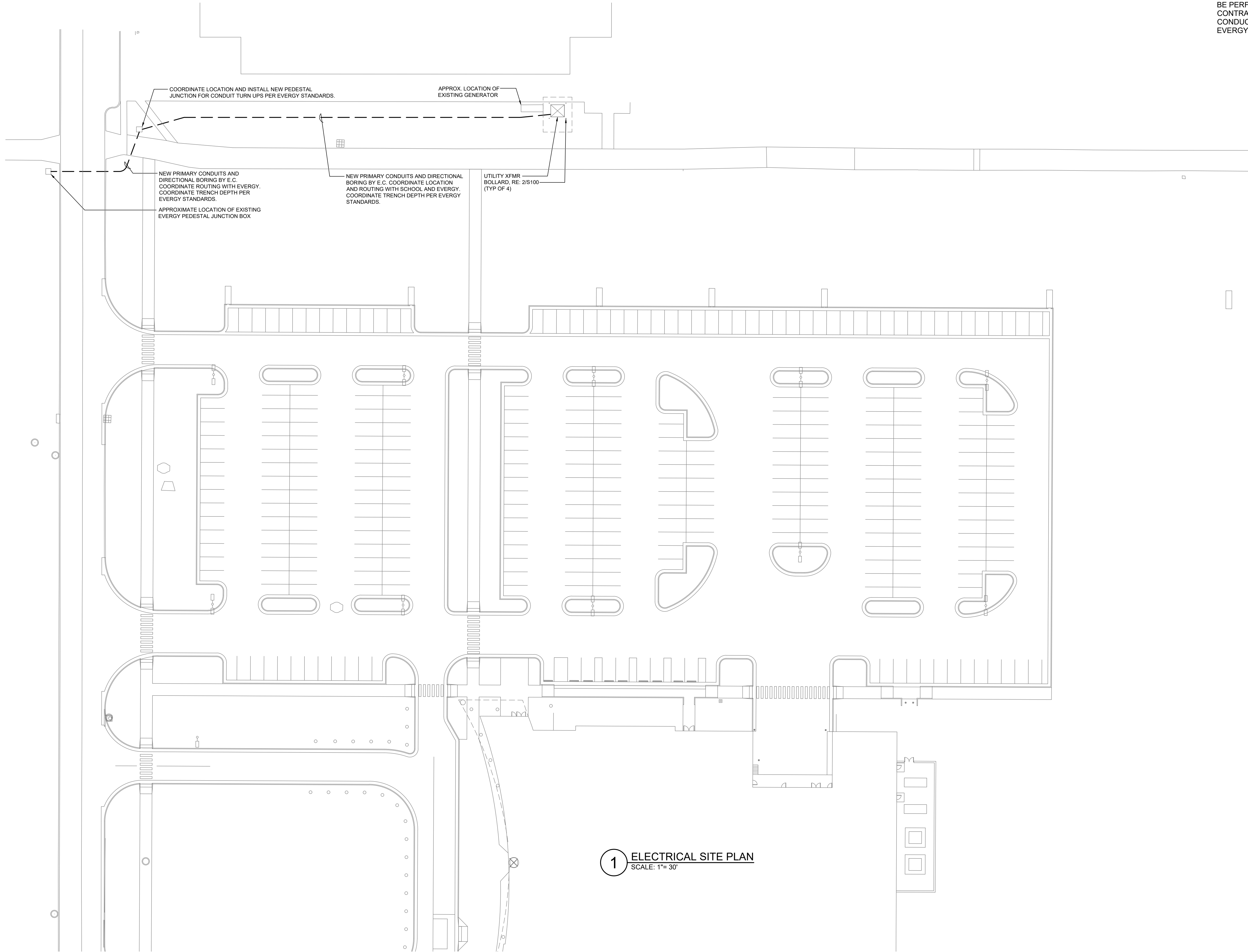
FIRE ALARM table with columns for symbol, description, and notes. Includes items like Control Module, etc.

HENDERSON ENGINEERS logo and contact information: 6836 LENEXA DRIVE, SUITE 300, LENEXA, KS 66244, TEL: 913.742.9000, FAX: 913.742.5001, WWW.HENDERSONENGINEERS.COM, KS. CORP/REGISTRATION NUMBER: E-325

PITTSBURGH STATE UNIVERSITY WEEDE FIELDHOUSE HVAC UPGRADES, 1701 S BROADWAY ST, PITTSBURGH, KS. DATE: 05-28-2021, DRAWN BY: NWS



06/01/2021, ELECTRICAL LEGEND, A-014285, E0.00, 100% BID AND PERMIT



ELECTRICAL GENERAL NOTES:
 1. ALL SITE (PRIMARY) ELECTRICAL WORK TO BE PERFORMED BY AN EVERGY CERTIFIED CONTRACTOR ONLY. PRIMARY CONDUCTORS AND TERMINATIONS BY EVERGY.

1 ELECTRICAL SITE PLAN
 SCALE: 1"= 30'

HENDERSON ENGINEERS
 8348 LENOVA DRIVE, SUITE 800
 LENOVA, KS 66214
 TEL 913.742.5000 FAX 913.742.5001
 WWW.HENDERSONENGINEERS.COM
 215001628
 KS CORPORATE LICENSE NUMBER E-325
 12/31/21

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
 1701 S BROADWAY ST
 PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY: NWS



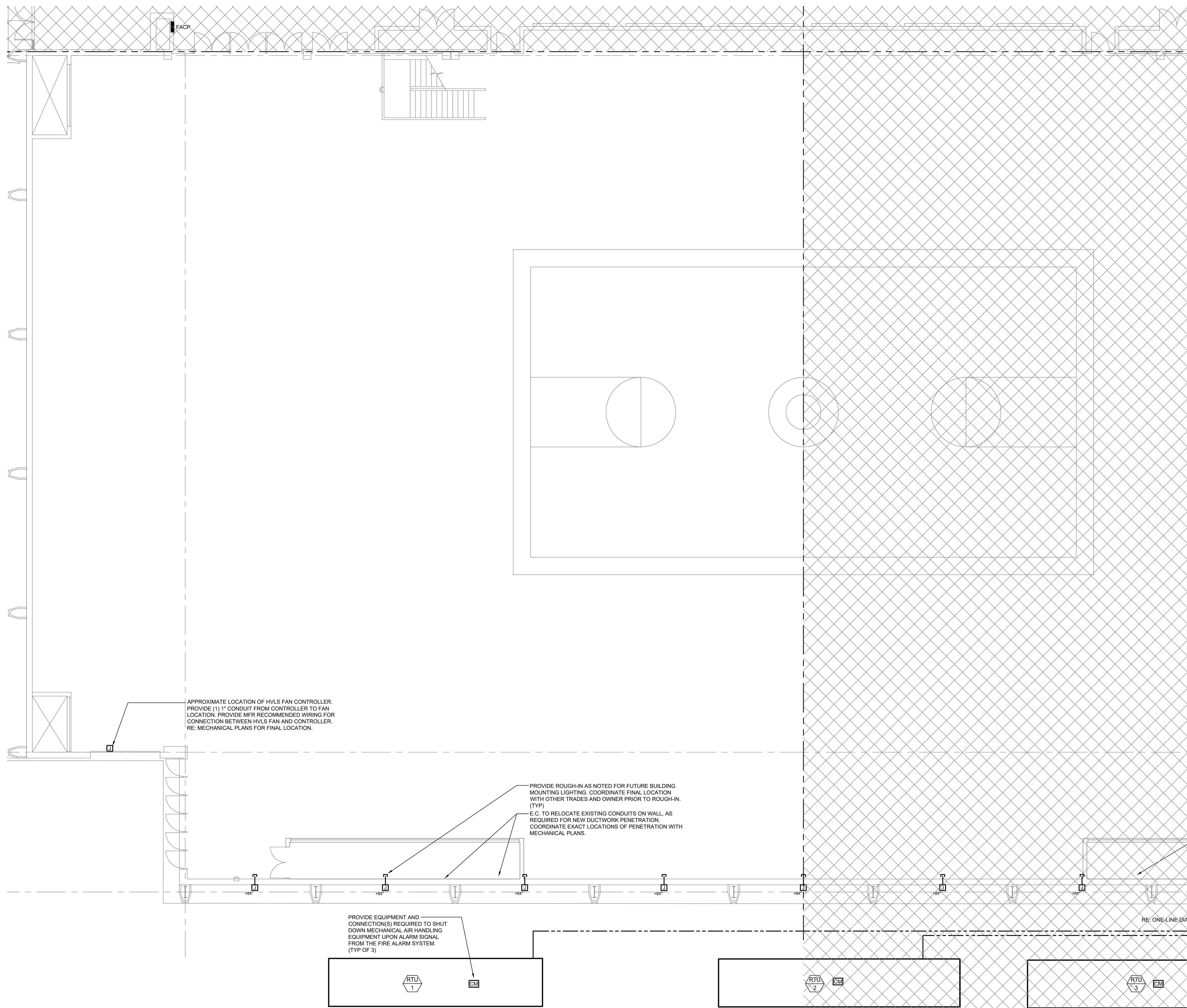
06/01/2021

ELECTRICAL SITE PLAN

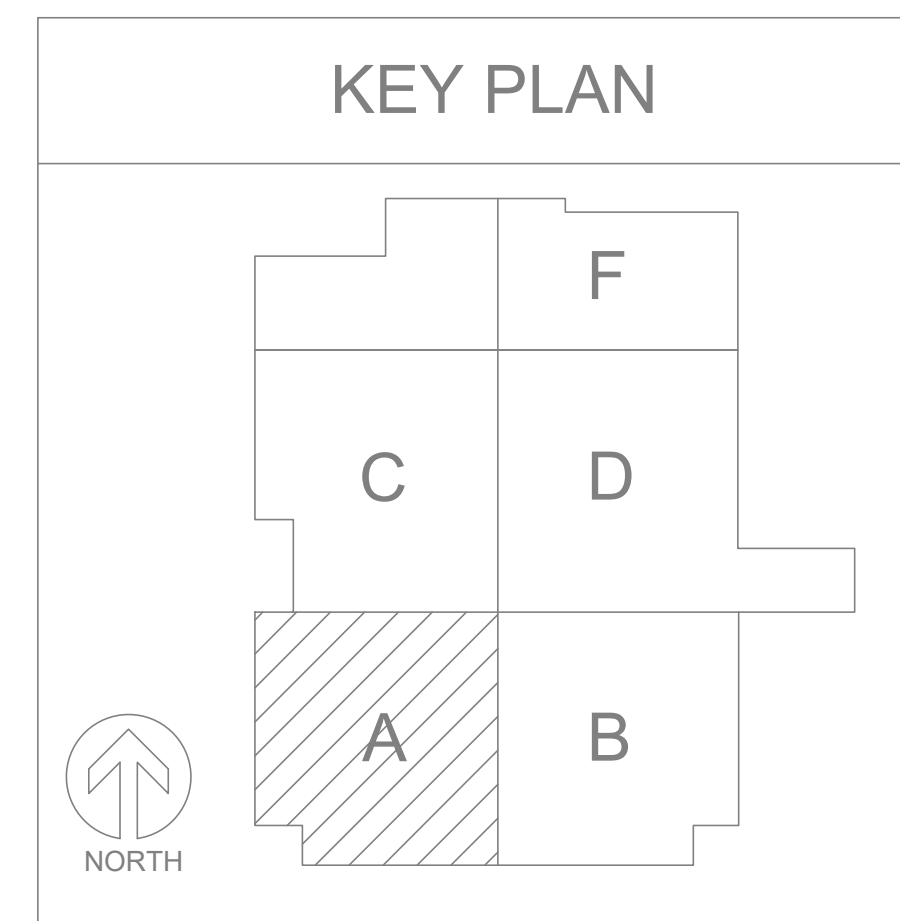
A-014285

E1.00

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1 ELECTRICAL POWER PLAN
LEVEL 1 - AREA A
 SCALE: 1/8"=1'-0"



HENDERSON
 ENGINEERS
 8348 LENEVA DRIVE, SUITE 300
 LENEVA, KS 66214
 TEL 913.742.3000 FAX 913.742.5001
 WWW.HENDERSONENGINEERS.COM
 215001628
 KS CORPORATE NUMBER E-325
 12/31/21

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**ELECTRICAL
 POWER PLAN**

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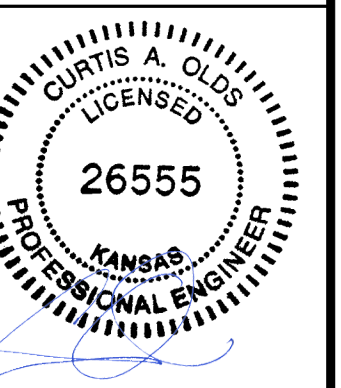
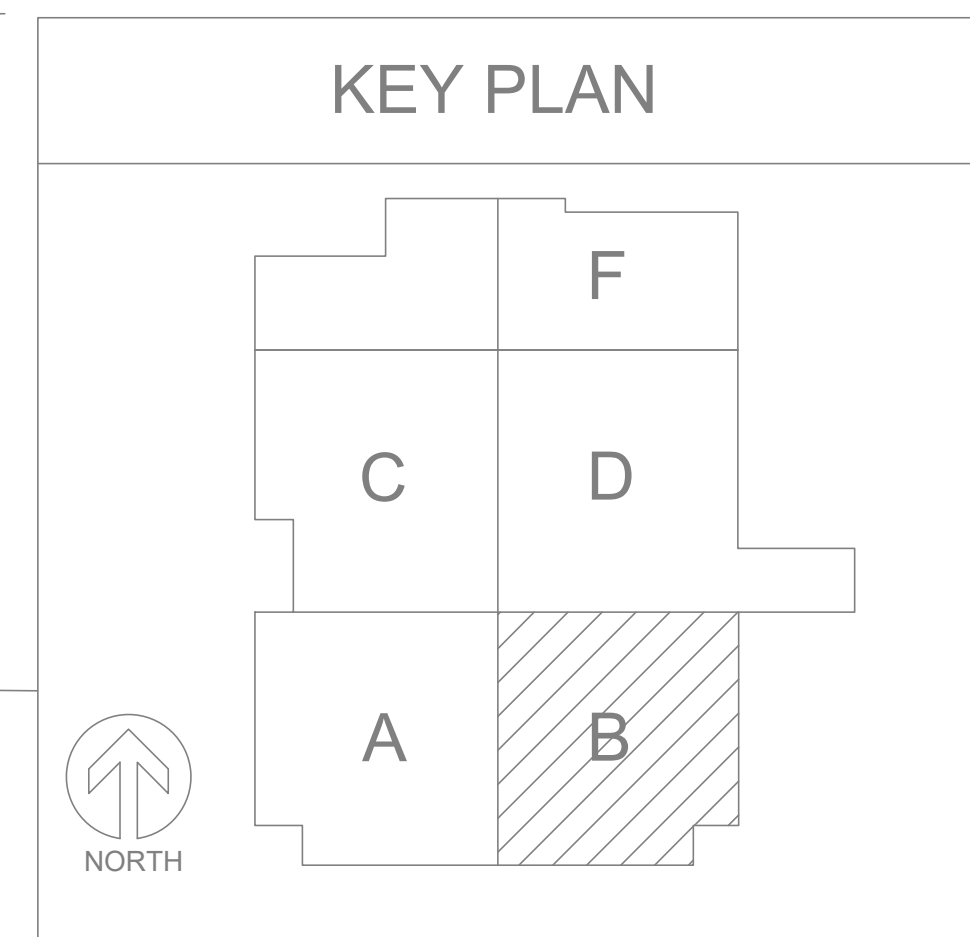
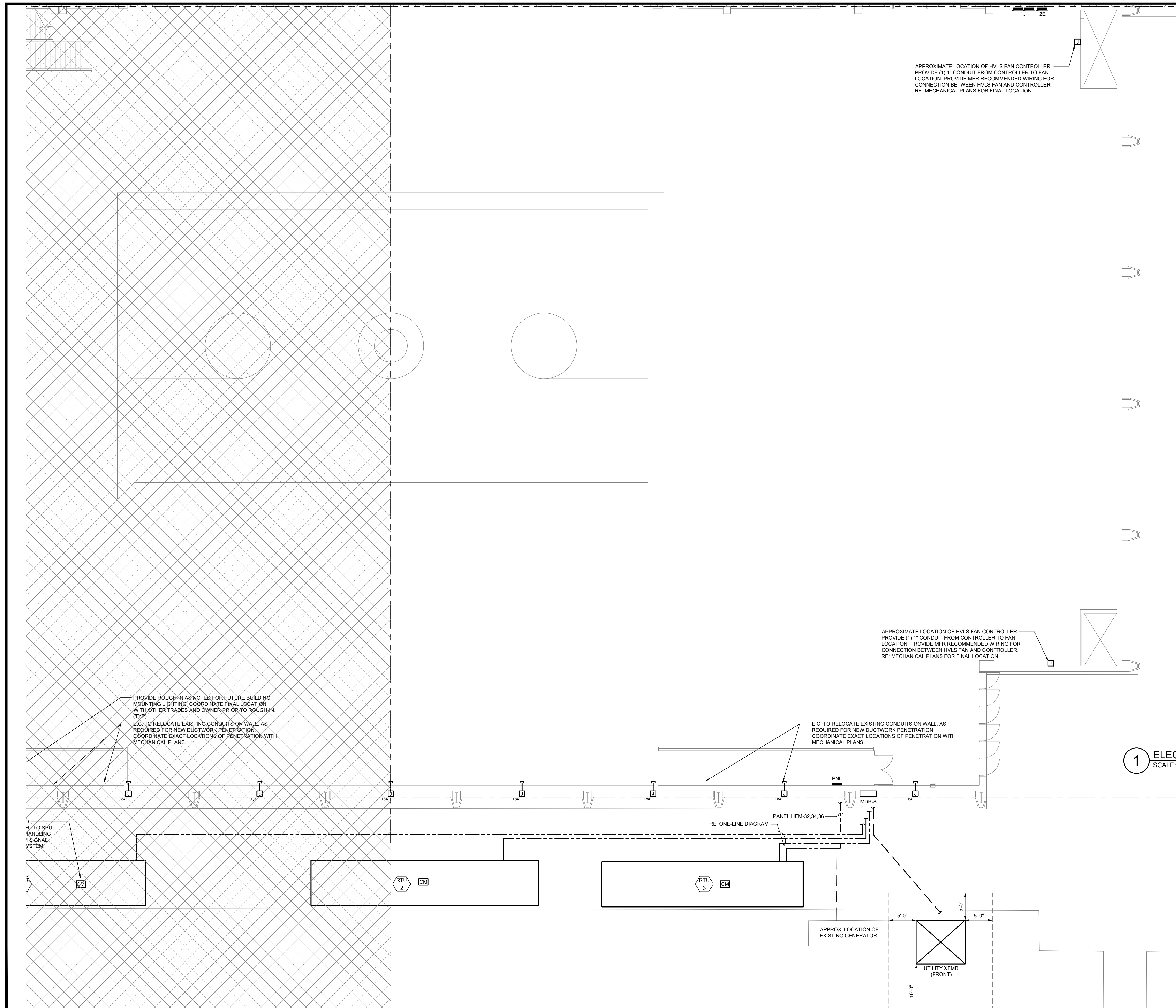
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DATE: 05-28-2021 DRAWN BY: NWS

1 ELECTRICAL POWER PLAN LEVEL 1 - AREA B
SCALE: 1/8"=1'-0"



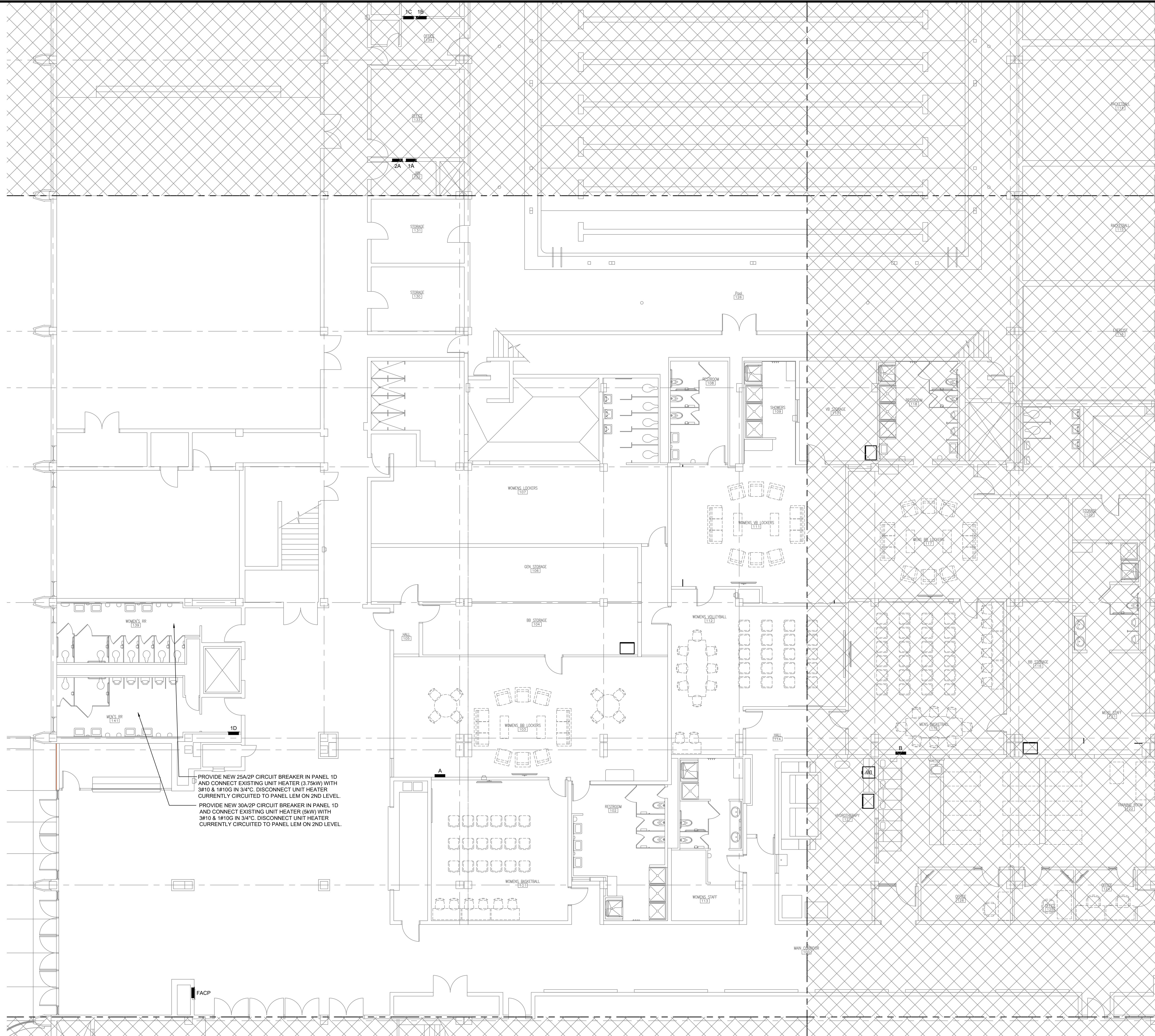
06/01/2021

ELECTRICAL POWER PLAN

A-014285

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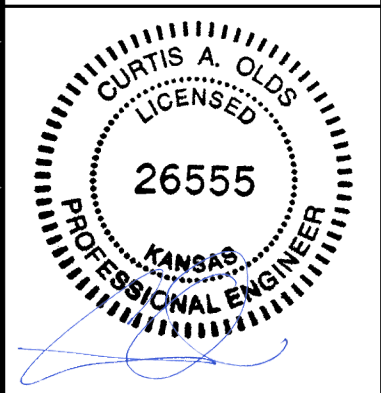
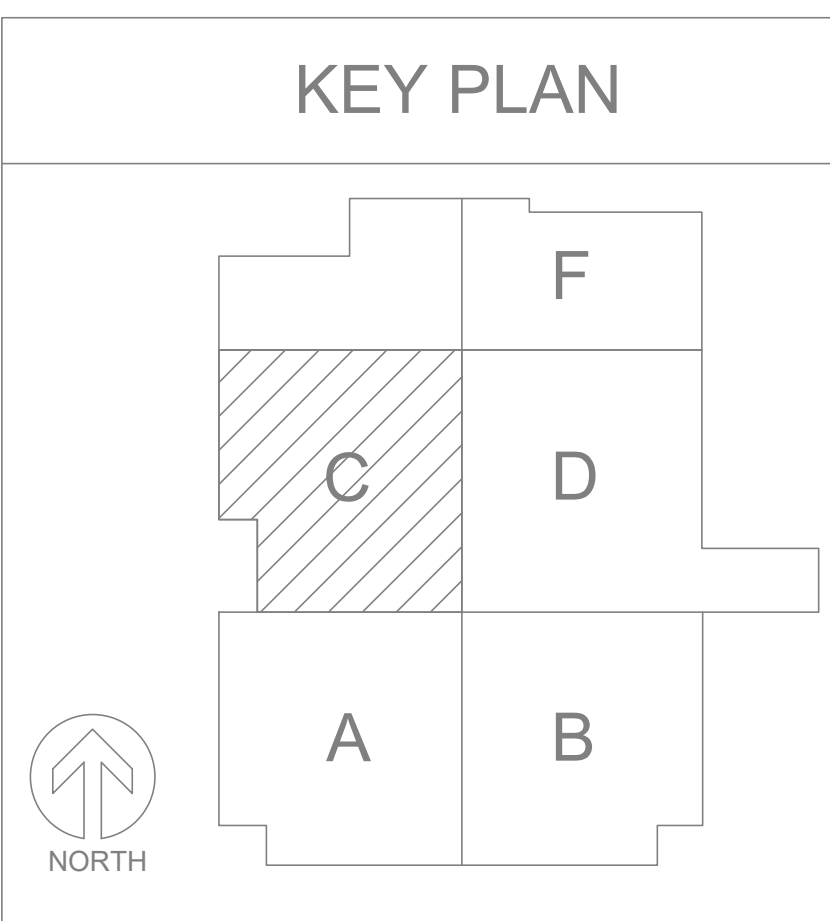
100% BID AND PERMIT



PROVIDE NEW 25A/2P CIRCUIT BREAKER IN PANEL 1D AND CONNECT EXISTING UNIT HEATER (3.75KW) WITH 3#10 & #10G IN 3/4" DISCONNECT UNIT HEATER CURRENTLY CIRCUITED TO PANEL LEM ON 2ND LEVEL.

PROVIDE NEW 30A/2P CIRCUIT BREAKER IN PANEL 1D AND CONNECT EXISTING UNIT HEATER (5KW) WITH 3#10 & #10G IN 3/4" DISCONNECT UNIT HEATER CURRENTLY CIRCUITED TO PANEL LEM ON 2ND LEVEL.

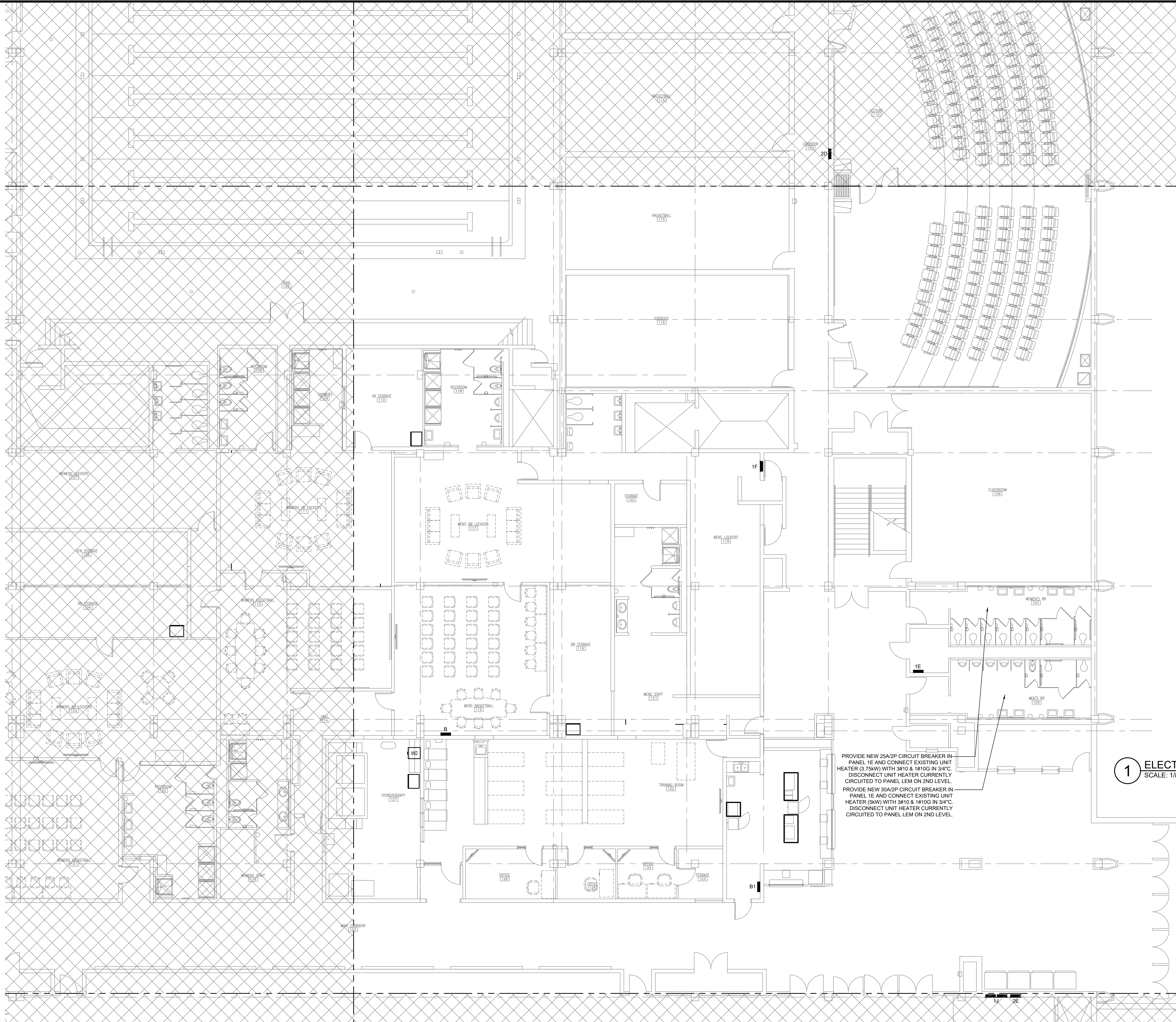
1 ELECTRICAL POWER PLAN
 LEVEL 1 - AREA C
 SCALE: 1/8"=1'-0"



06/01/2021
**ELECTRICAL
 POWER PLAN**
A-014285
E101C
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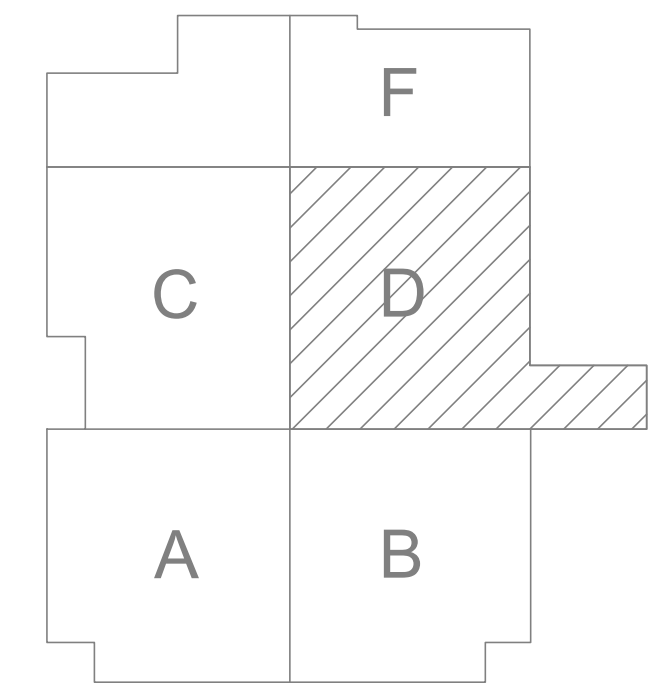


PROVIDE NEW 25A/2P CIRCUIT BREAKER IN PANEL 1E AND CONNECT EXISTING UNIT HEATER (3.75KW) WITH 3#10 & 1#10G IN 3/4" C. DISCONNECT UNIT HEATER CURRENTLY CIRCUITED TO PANEL LEM ON 2ND LEVEL.

PROVIDE NEW 30A/2P CIRCUIT BREAKER IN PANEL 1E AND CONNECT EXISTING UNIT HEATER (5KW) WITH 3#10 & 1#10G IN 3/4" C. DISCONNECT UNIT HEATER CURRENTLY CIRCUITED TO PANEL LEM ON 2ND LEVEL.

1 ELECTRICAL POWER PLAN LEVEL 1 - AREA D
SCALE: 1/8"=1'-0"

KEY PLAN



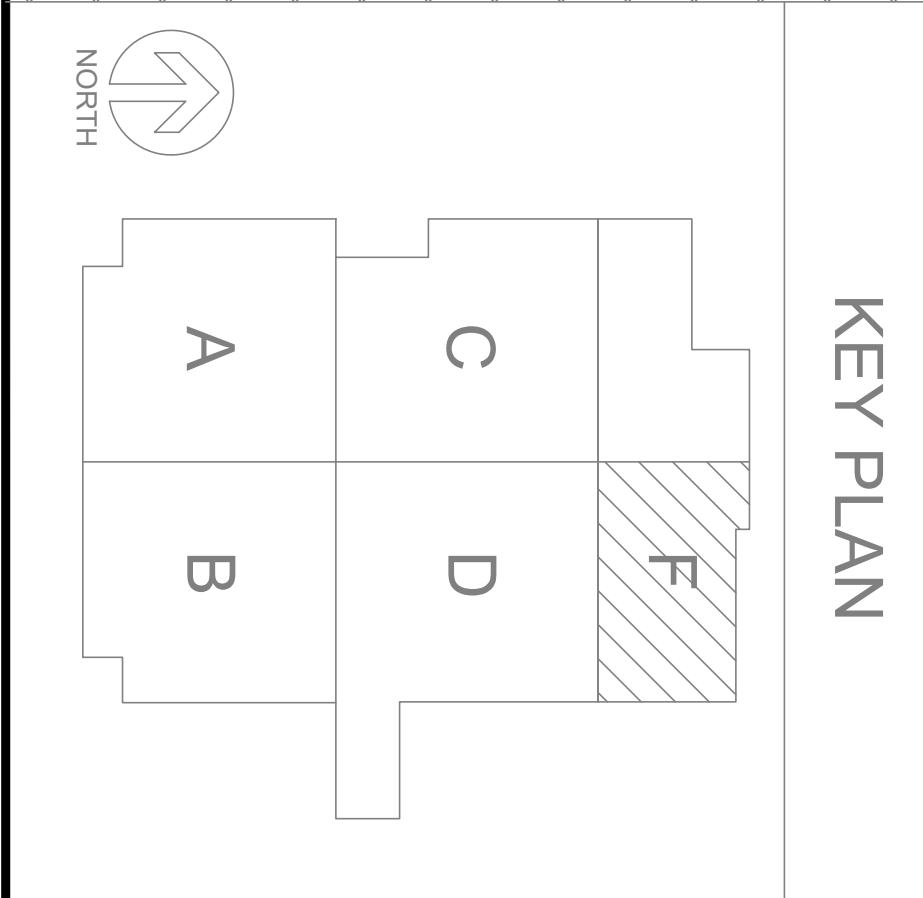
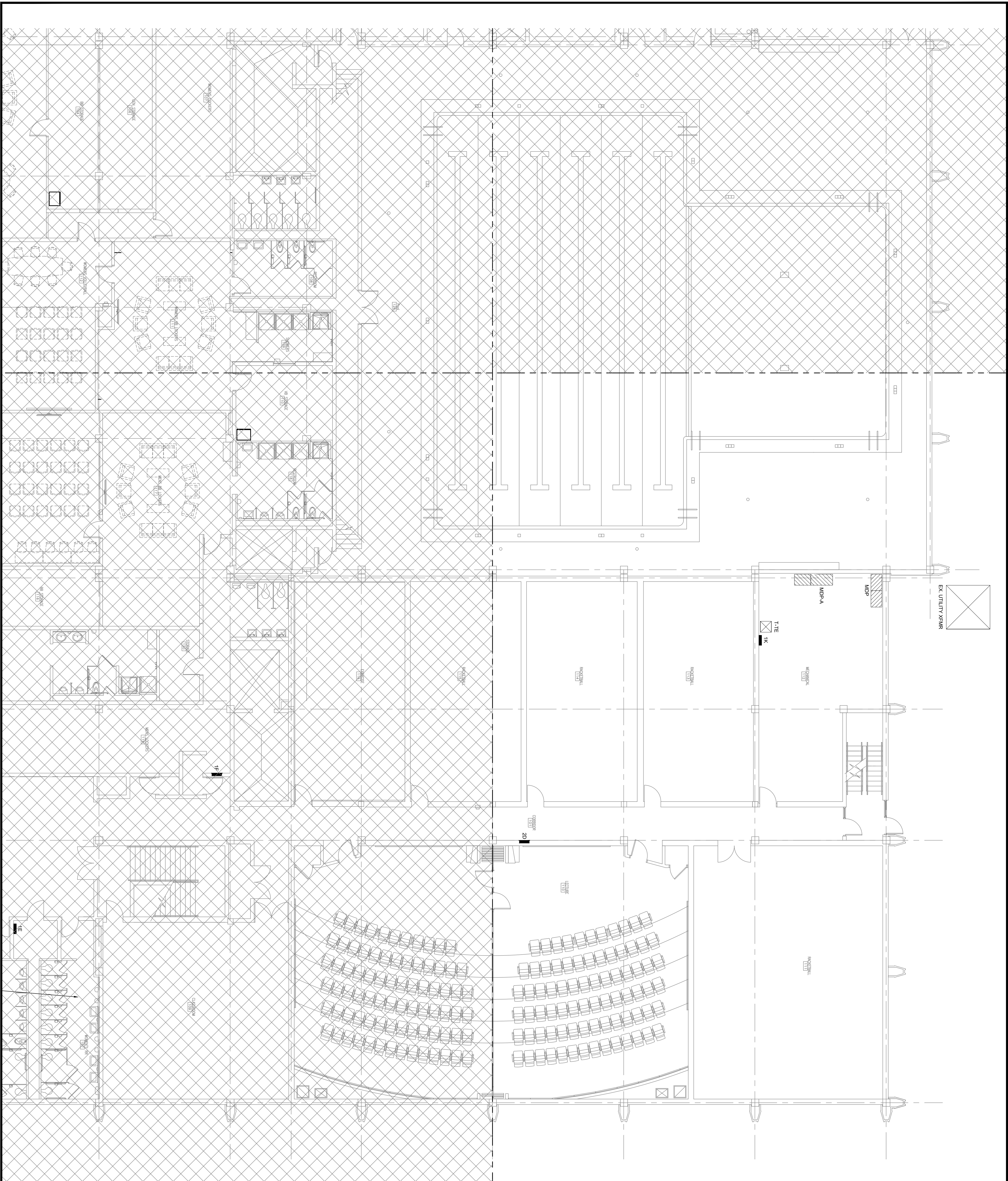
06/01/2021

ELECTRICAL POWER PLAN

A-014285

E101D

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1
 ELECTRICAL POWER PLAN
 LEVEL 1 - AREA F
 SCALE: 1/8"=1'-0"

08/01/2021

ELECTRICAL POWER PLAN

A-014285

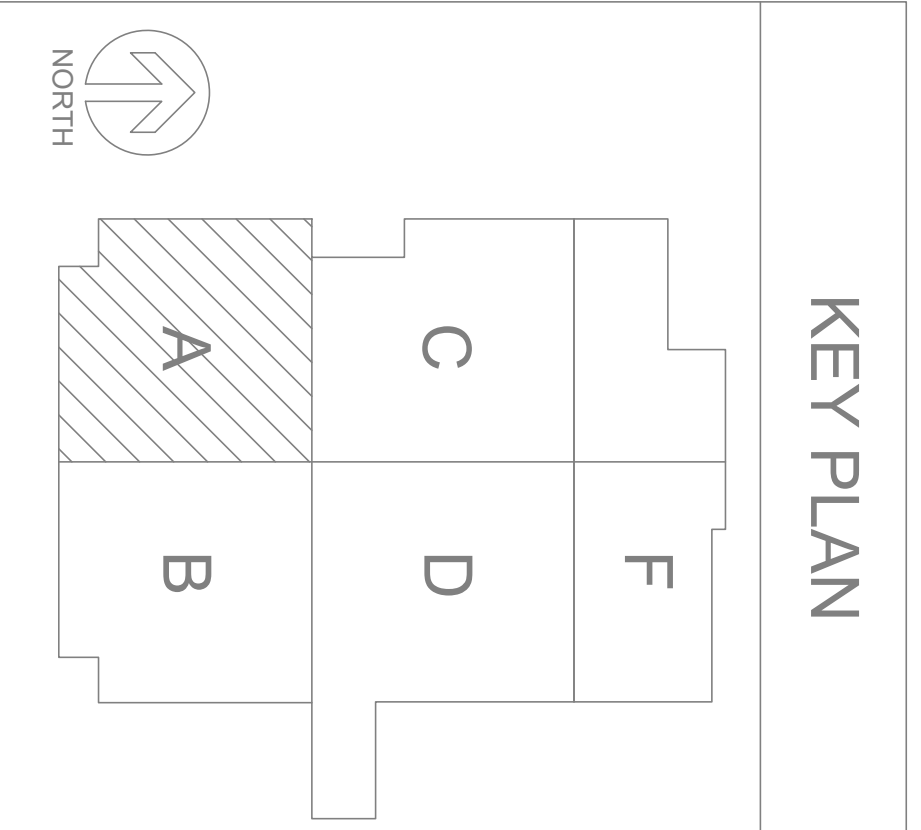
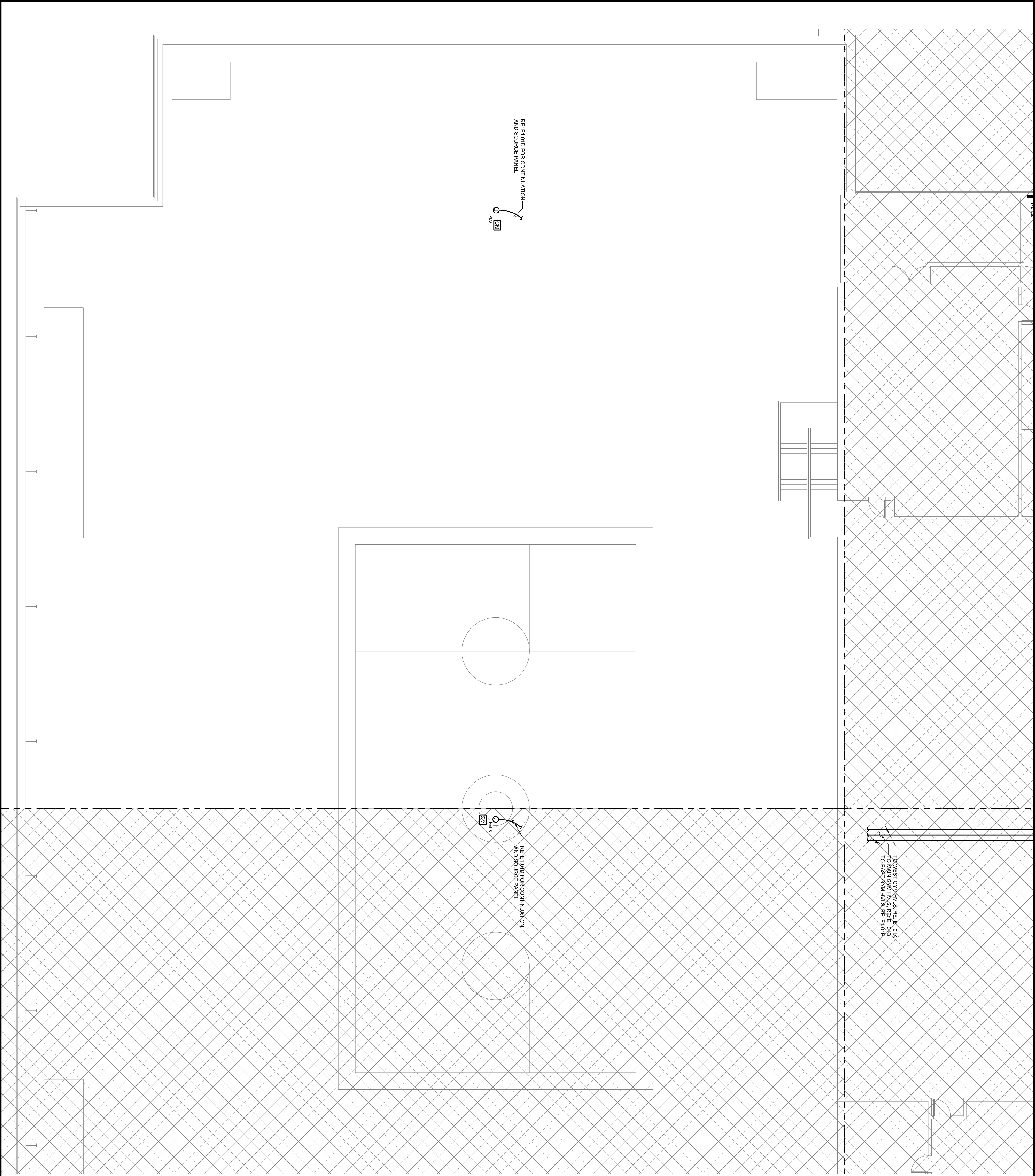
E101F

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 1701 S BROADWAY ST
 PITTSBURG, KS
 DATE:05-28-2021 DRAWN BY: NWS

HENDERSON ENGINEERS
 8345 LENEXA DRIVE, SUITE 300
 LENEXA, KS 66214
 TEL 913.742.5000 FAX 913.742.5001
 WWW.HENDERSONENGINEERS.COM

2150001628
 KS. CORPORATE NUMBER: E-325
 12/31/21

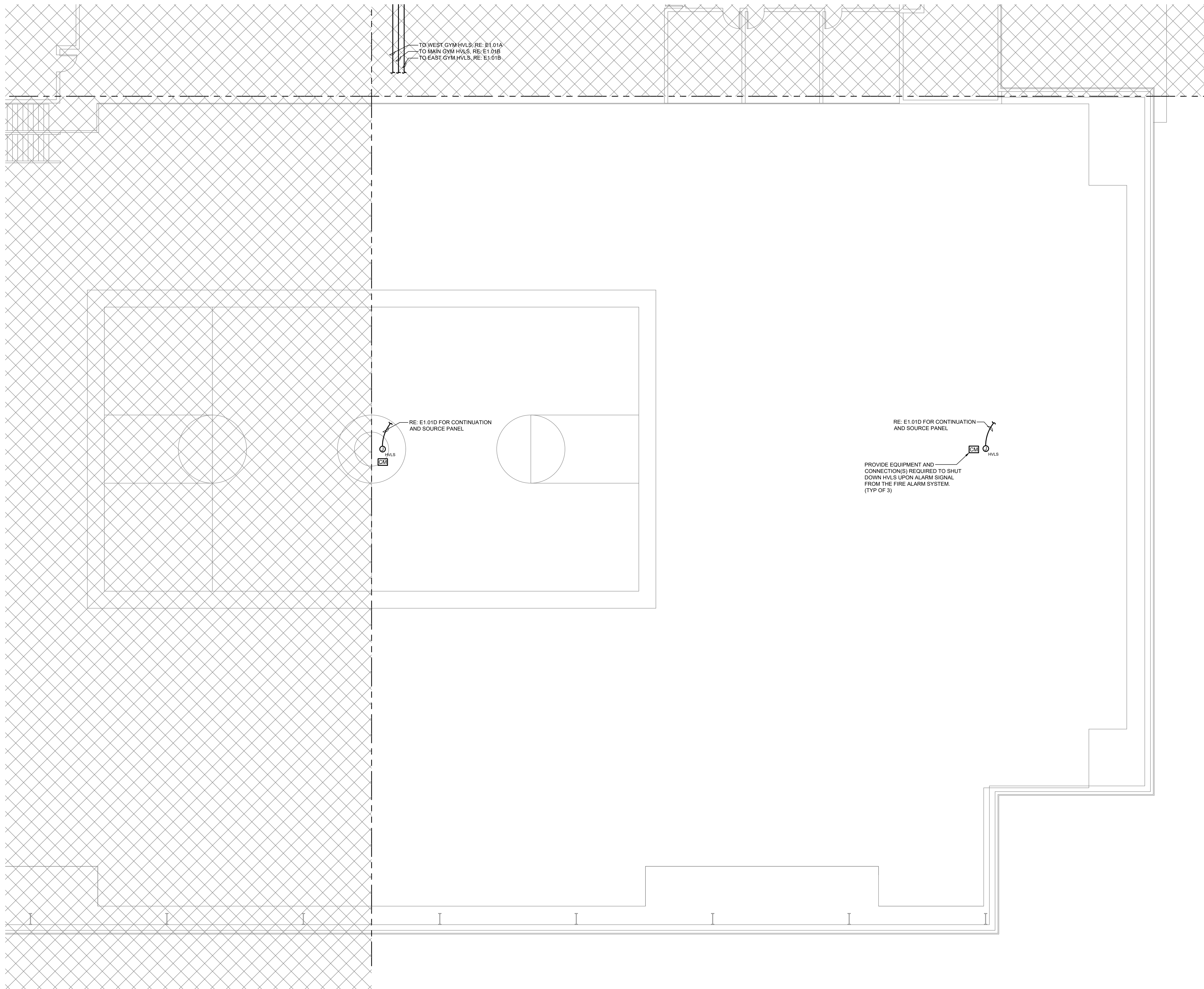


1 ELECTRICAL POWER PLAN
 LEVEL 2 - AREA A
 SCALE: 1/8"=1'-0"

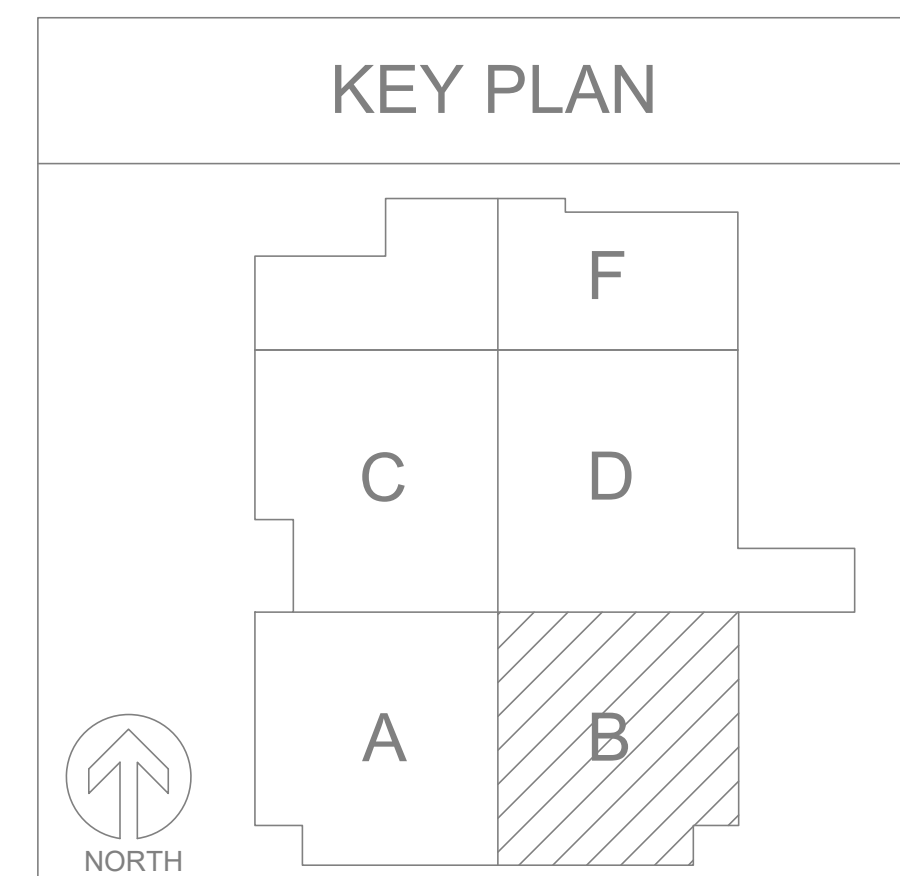
08/01/2021
 CURTIS A. OLDS
 26555
 PROFESSIONAL ENGINEER
 KANSAS
 E102A
 100% BD
 AND PERMIT
 A-014285
 ELECTRICAL
 POWER PLAN

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
 1701 S BROADWAY ST
 PITTSBURG, KS
 DATE:05-28-2021 DRAWN BY: NWS

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 8345 LENEXA DRIVE, SUITE 300
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 2150001628
 KS. CORPORATE NUMBER: E-325
 12/31/21



1 ELECTRICAL POWER PLAN LEVEL 2 - AREA B
SCALE: 1/8"=1'-0"



HENDERSON
ENGINEERS
8348 LENOVA DRIVE, SUITE 300
LENEA, KS 66214
TEL: 913.742.3000 FAX: 913.742.5001
WWW.HENDERSONENGINEERS.COM
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KS CORPORATE NUMBER: E-325
12/31/21

PITTSBURG STATE UNIVERSITY
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DATE: 05-28-2021 DRAWN BY: NWS



06/01/2021

**ELECTRICAL
POWER PLAN**

A-014285

E1.02B

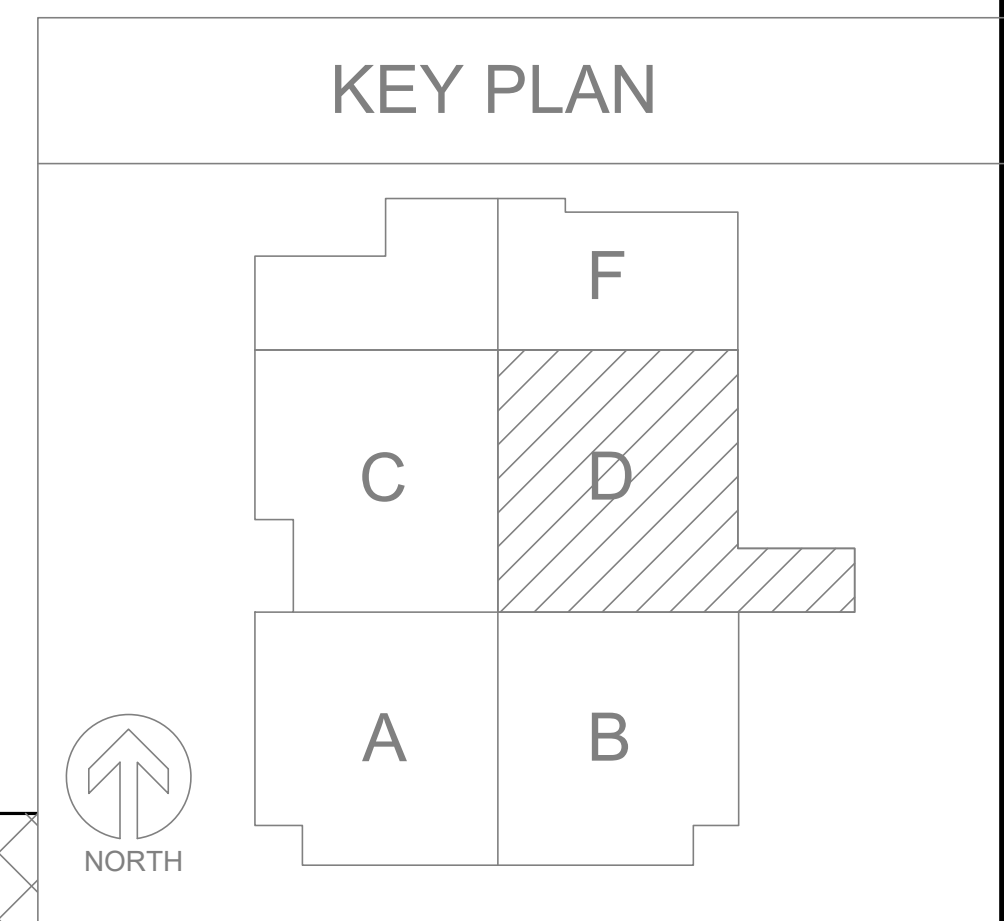
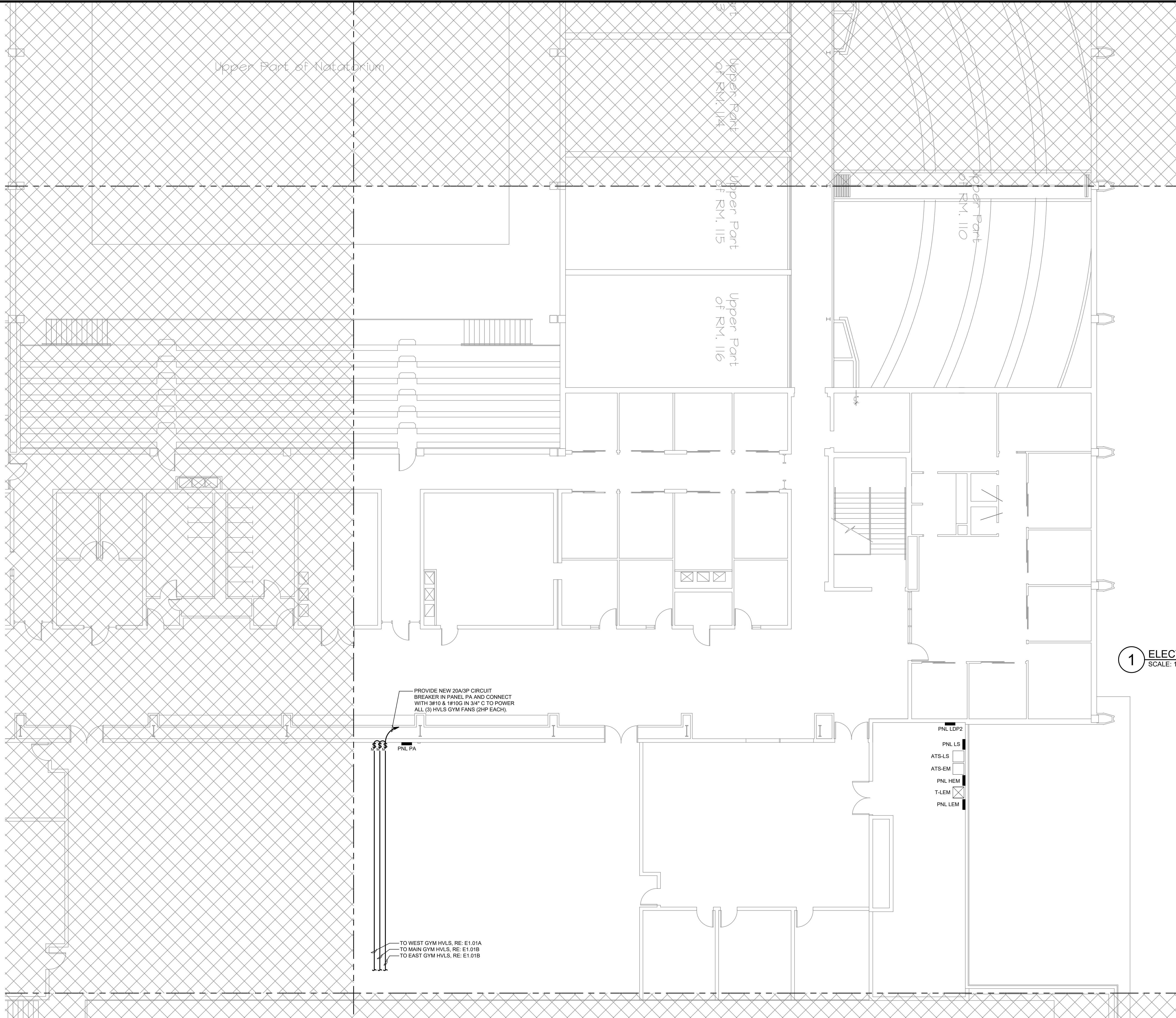
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AND PERMIT**

CURTIS A. OLDS

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PITTSBURG, KS

DATE 05-28-2021 DRAWN BY: NWS

1 ELECTRICAL POWER PLAN LEVEL 2 - AREA D
SCALE: 1/8"=1'-0"



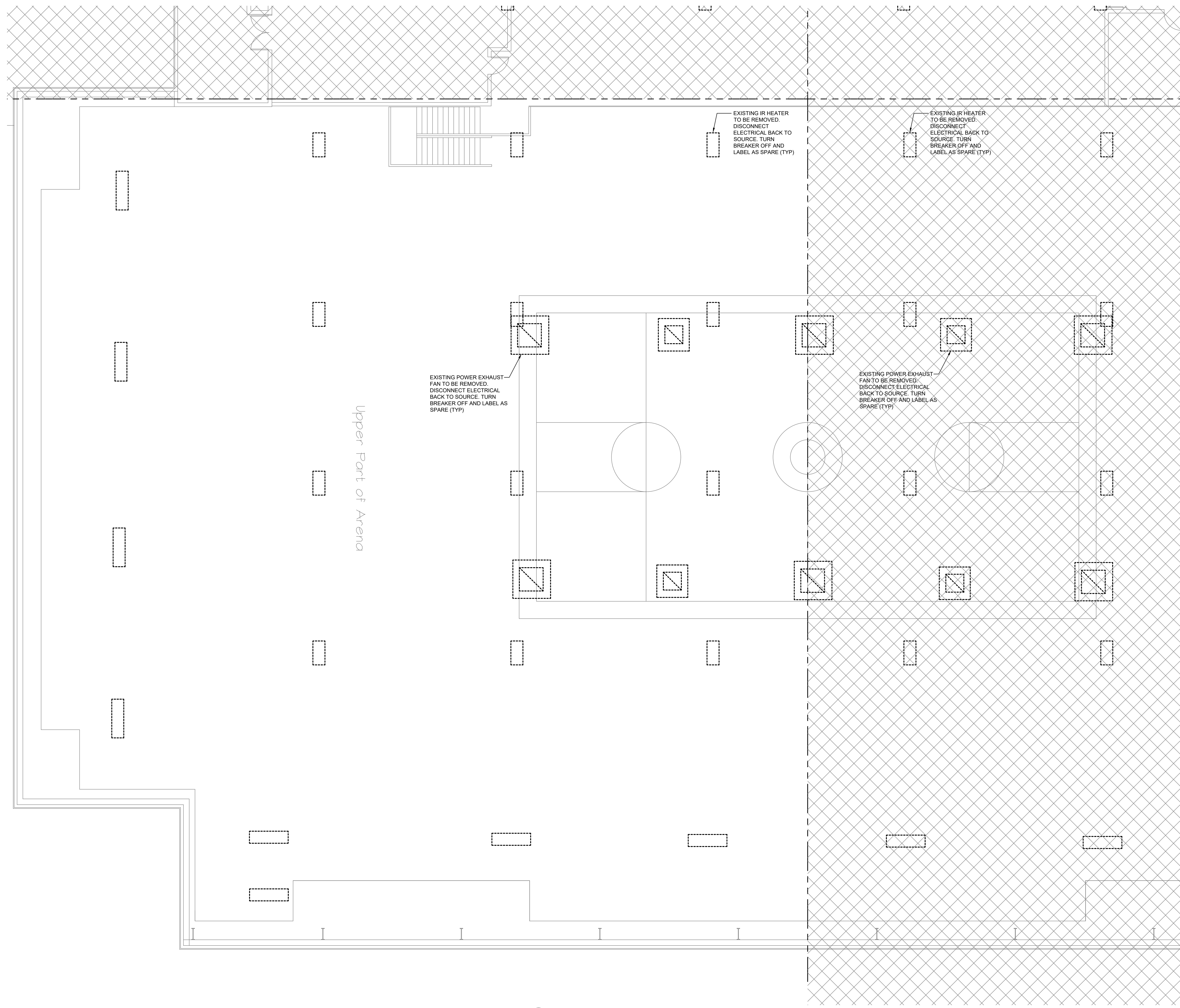
06/01/2021

**ELECTRICAL
POWER PLAN**

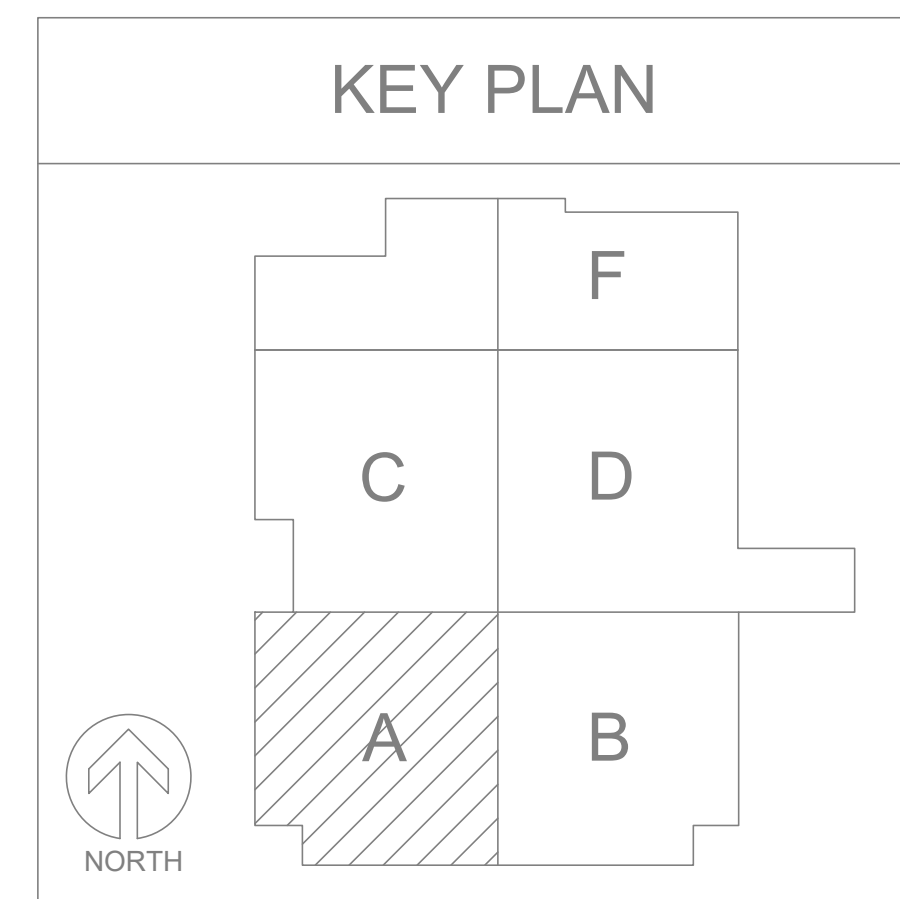
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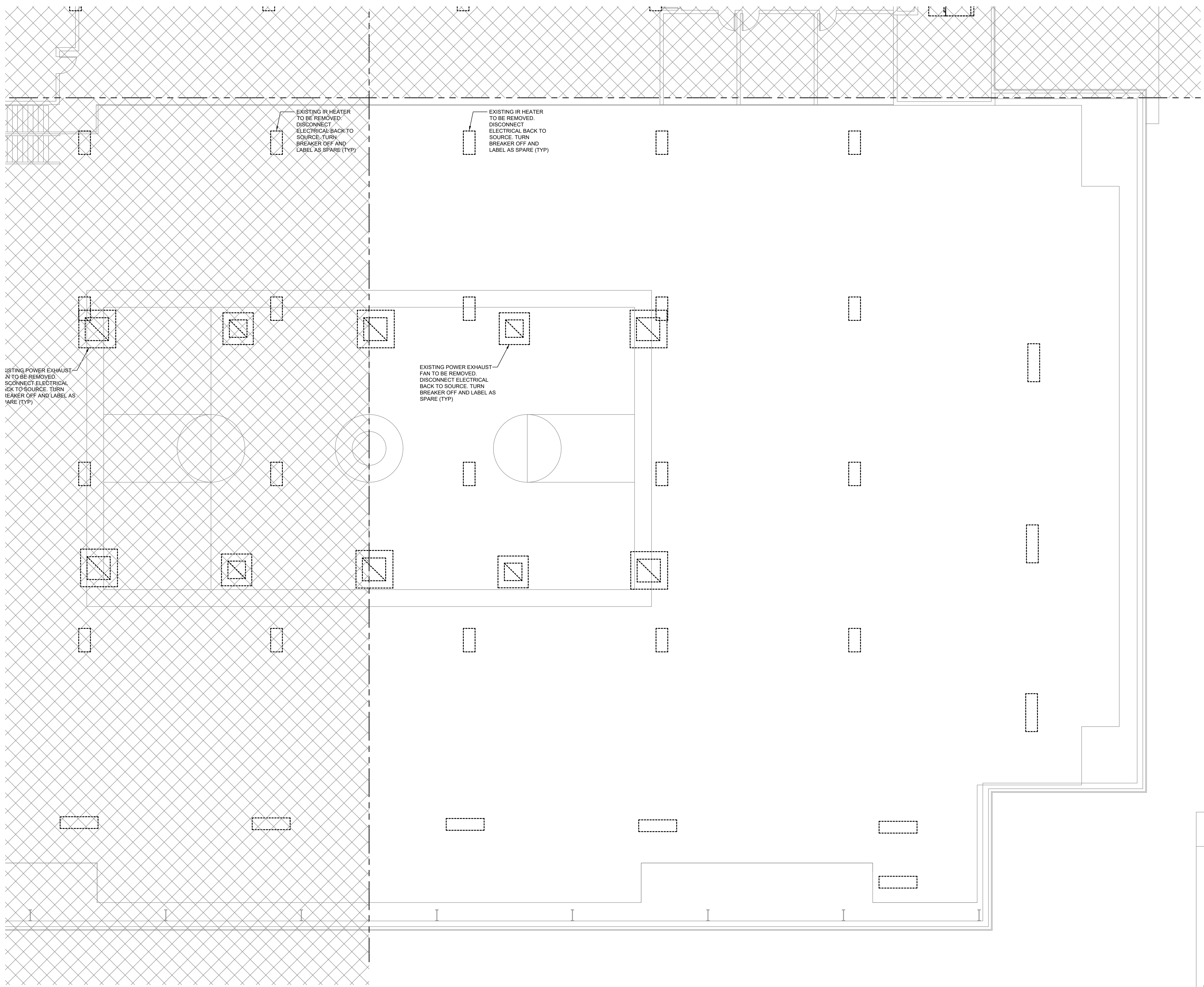
**100% BID
AND PERMIT**



1 ELECTRICAL DEMOLITION POWER PLAN LEVEL 2 - AREA A
SCALE: 1/8"=1'-0"



CURTIS A. OLDS



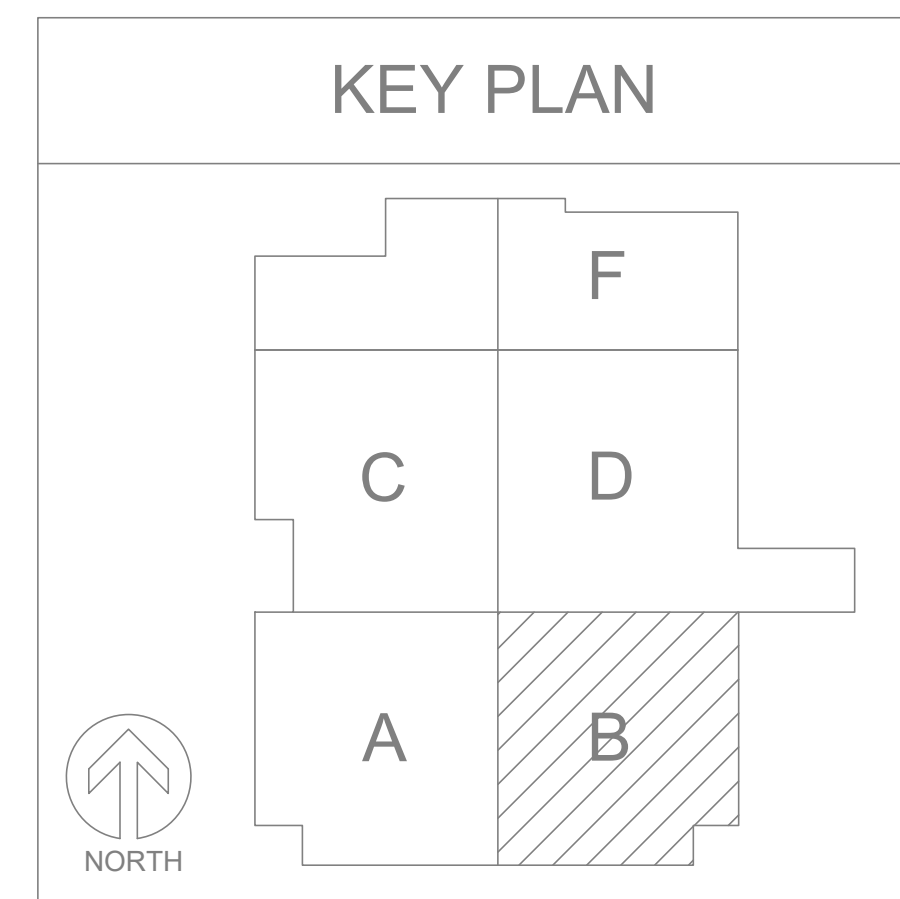
EXISTING IR HEATER TO BE REMOVED. DISCONNECT ELECTRICAL BACK TO SOURCE. TURN BREAKER OFF AND LABEL AS SPARE (TYP)

EXISTING IR HEATER TO BE REMOVED. DISCONNECT ELECTRICAL BACK TO SOURCE. TURN BREAKER OFF AND LABEL AS SPARE (TYP)

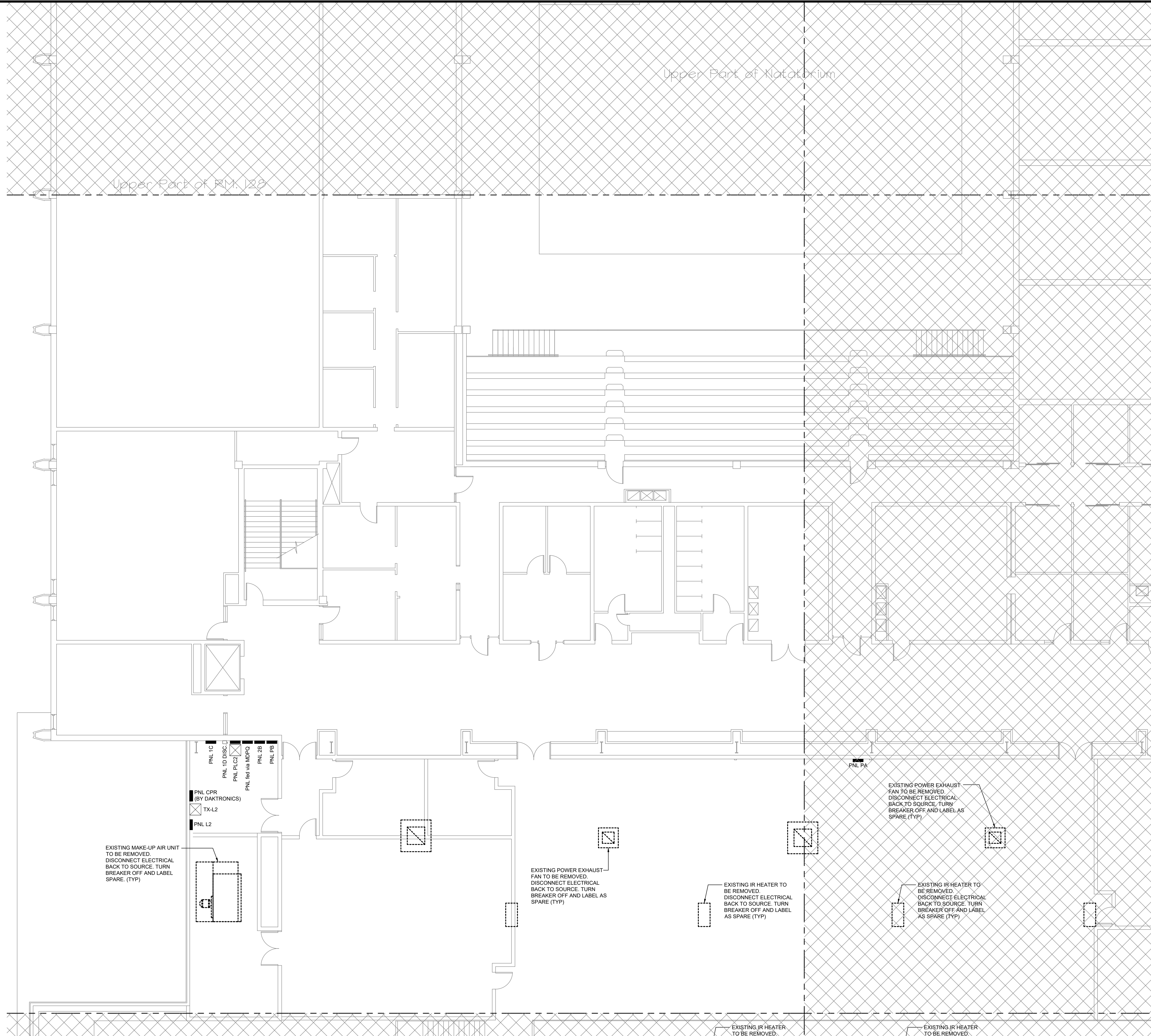
EXISTING POWER EXHAUST FAN TO BE REMOVED. DISCONNECT ELECTRICAL BACK TO SOURCE. TURN BREAKER OFF AND LABEL AS SPARE (TYP)

EXISTING POWER EXHAUST FAN TO BE REMOVED. DISCONNECT ELECTRICAL BACK TO SOURCE. TURN BREAKER OFF AND LABEL AS SPARE (TYP)

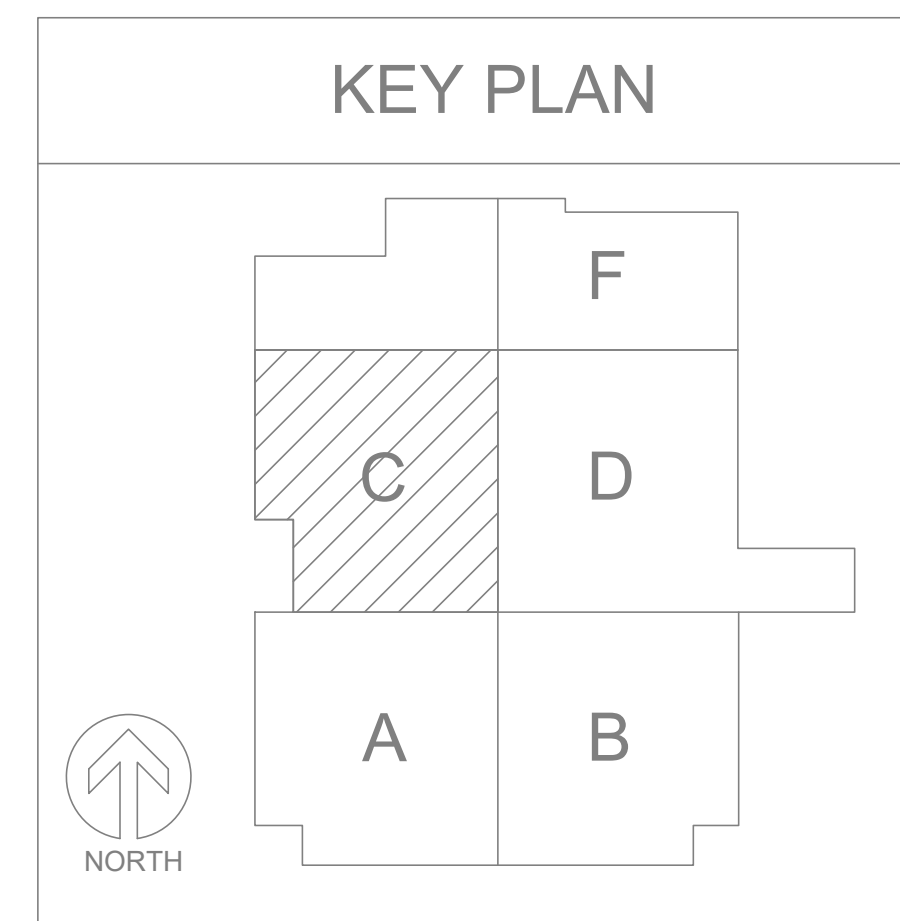
1 ELECTRICAL DEMOLITION POWER PLAN LEVEL 2 - AREA B
SCALE: 1/8"=1'-0"



CURTIS A. OLDS



1 ELECTRICAL POWER DEMOLITION PLAN
 LEVEL 2 - AREA C
 SCALE: 1/8"=1'-0"



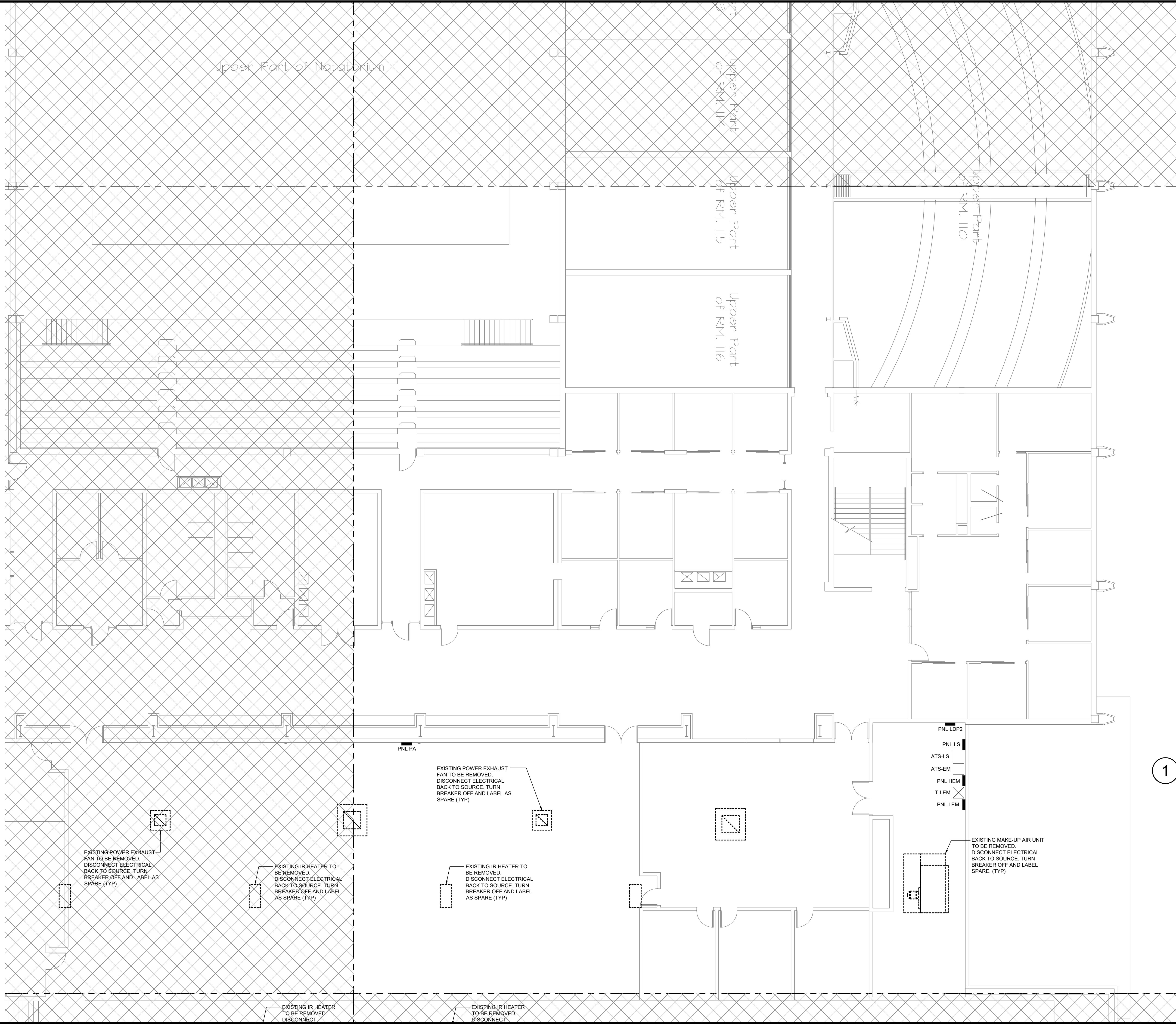
06/01/2021

**ELECTRICAL
 POWER DEMO PLAN**

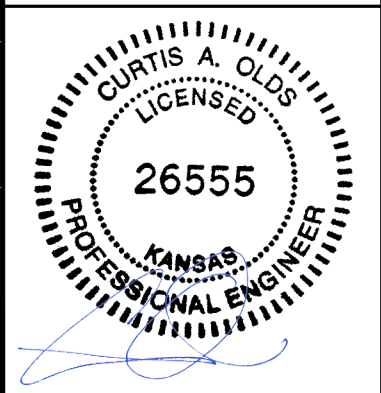
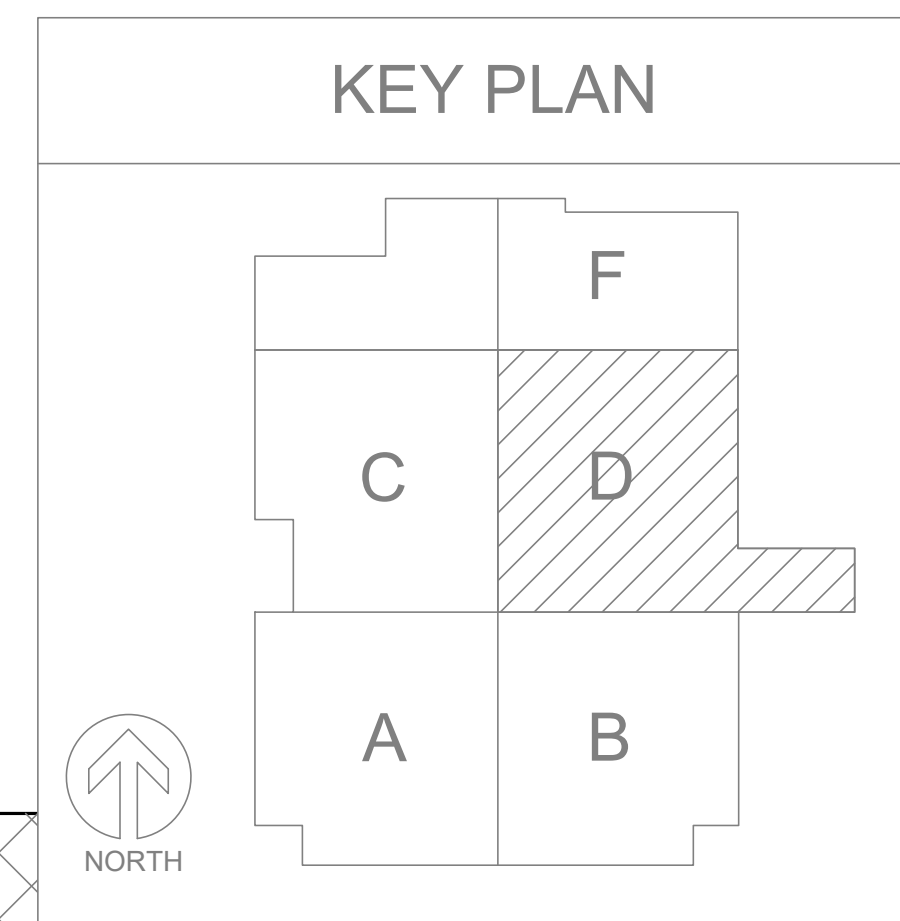
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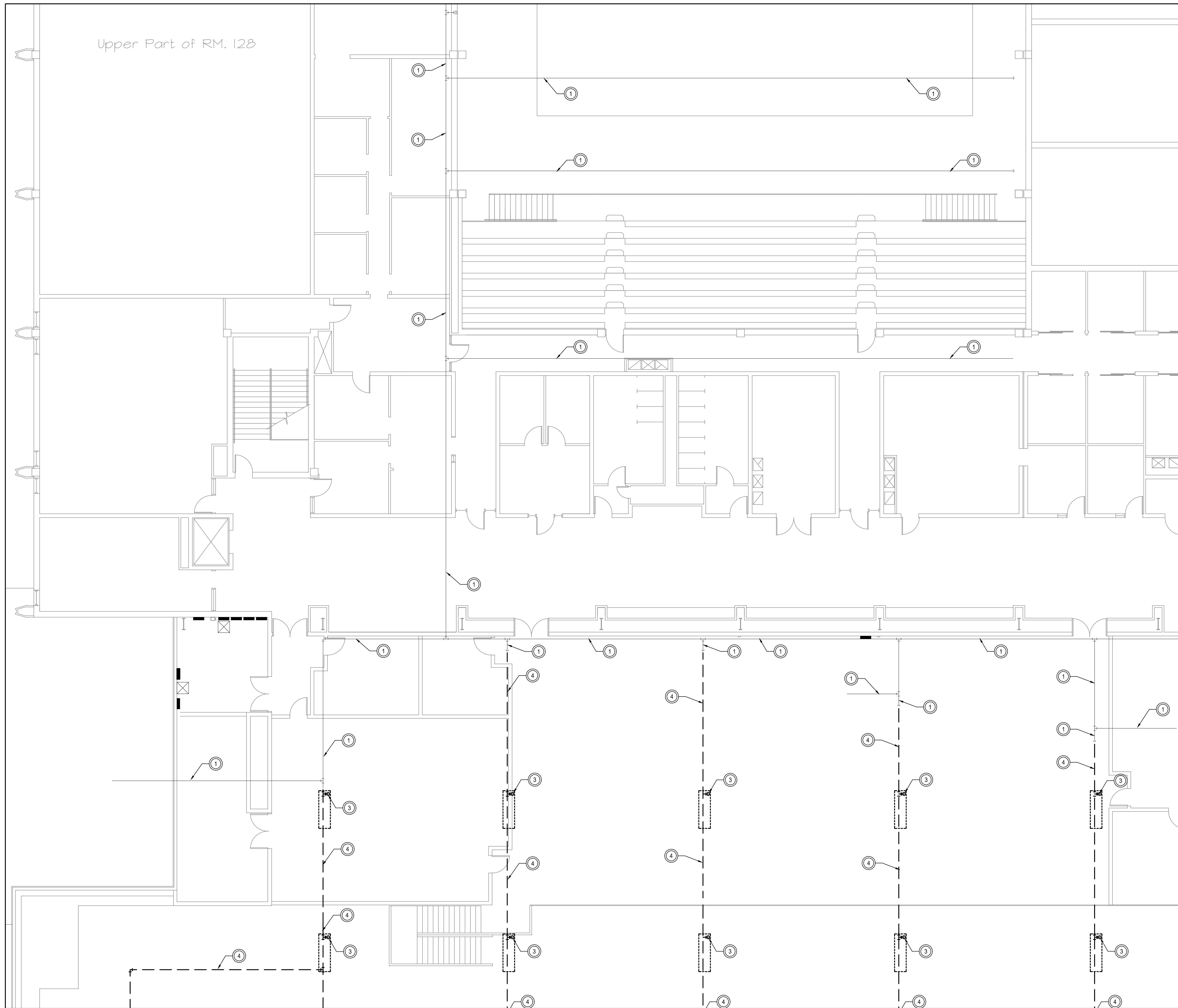
ED1.02C

**100% BID
 AND PERMIT**



1 ELECTRICAL POWER DEMOLITION PLAN
LEVEL 2 - AREA D
SCALE: 1/8"=1'-0"



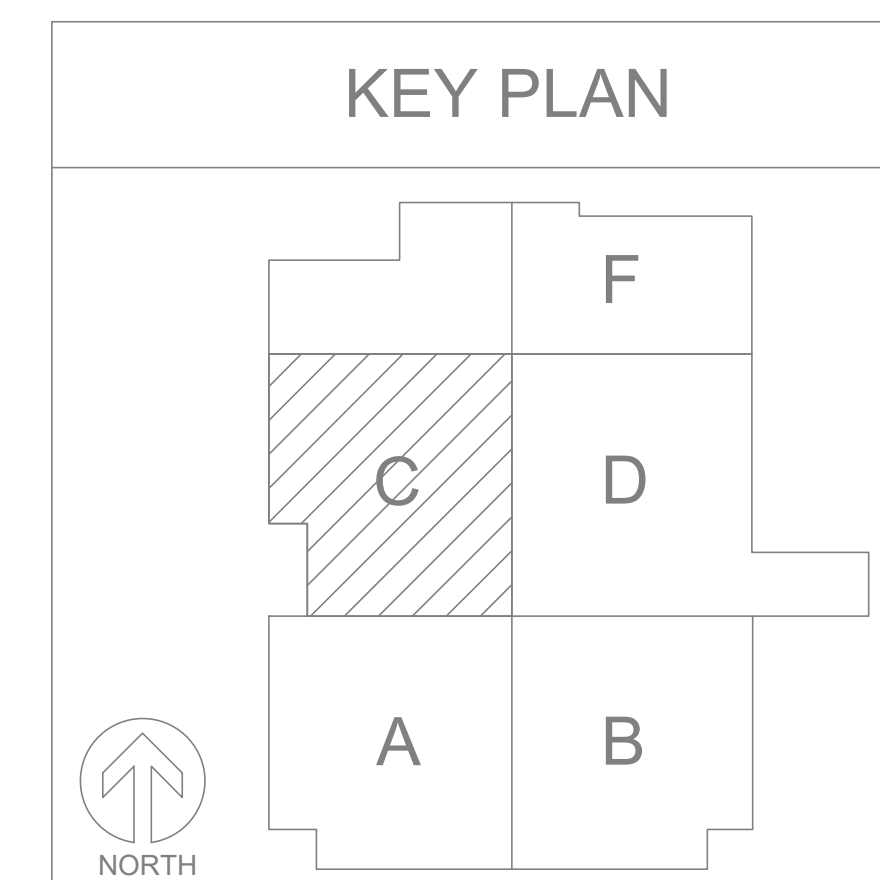


Upper Part of RM. 128

PLUMBING DEMOLITION NOTES:

1. EXISTING GAS PIPING TO REMAIN AND BE REUSED.
2. EXISTING GAS METER AND REGULATOR ASSEMBLY TO REMAIN AND BE REUSED, LOCATED ON THE NORTHEAST CORNER OF THE BUILDING.
3. REMOVE GAS DROP, SUPPORTS, ACCESSORIES AND CONNECTION TO DEMO'D INFRARED HEATER. FIELD VERIFY EXIST LOCATION AND ROUTING. SEE HVAC DRAWINGS FOR MORE INFORMATION. DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER.
4. ADD ALTERNATE 1: REMOVE GAS PIPING, HANGERS AND ACCESSORIES BACK TO AS CLOSE TO THE MAIN AS POSSIBLE OR AS INDICATED ON DRAWINGS. FIELD VERIFY EXACT LOCATION. BASE BID: DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER. ABANDON PIPING IN PLACE. LABEL PIPING ABANDONED IN PLACE.
5. REMOVE EXISTING GENERATOR GAS BRANCH PIPING TO PENETRATION OF EXTERIOR WALL AND CAP PIPE FOR RECONNECTION UNDER NEW WORK. COORDINATE ANY SHUT-DOWN OF THE EMERGENCY GENERATOR WITH THE OWNER'S REPRESENTATIVE AND ALL OTHER TRADES. CONTRACTOR TO PATCH EXTERIOR WALL PENETRATION. SEE ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.

1 PLUMBING DEMOLITION PLAN LEVEL 2 - AREA C
SCALE: 1/8"=1'-0"



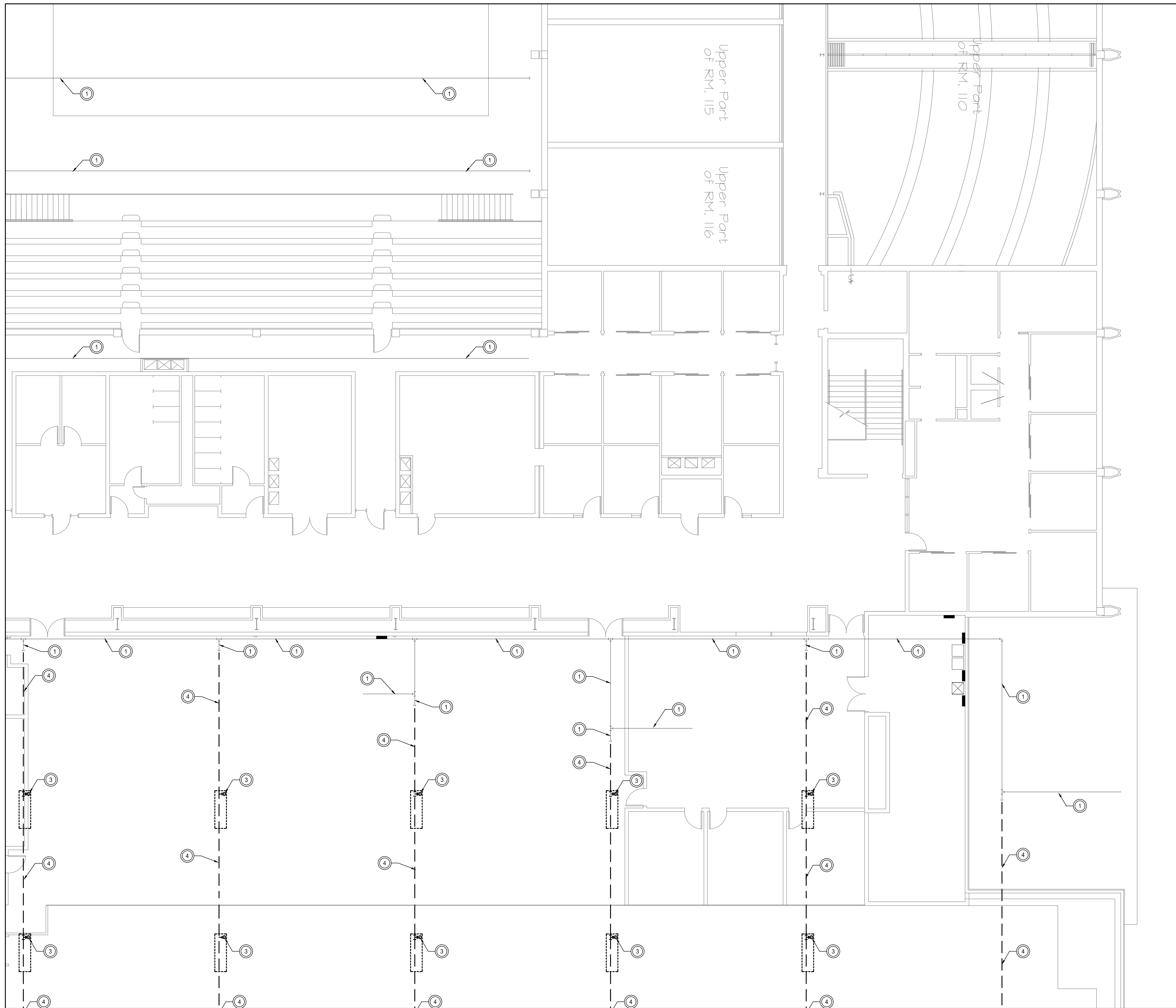
06/02/2021

PLUMBING DEMO FLOOR PLAN

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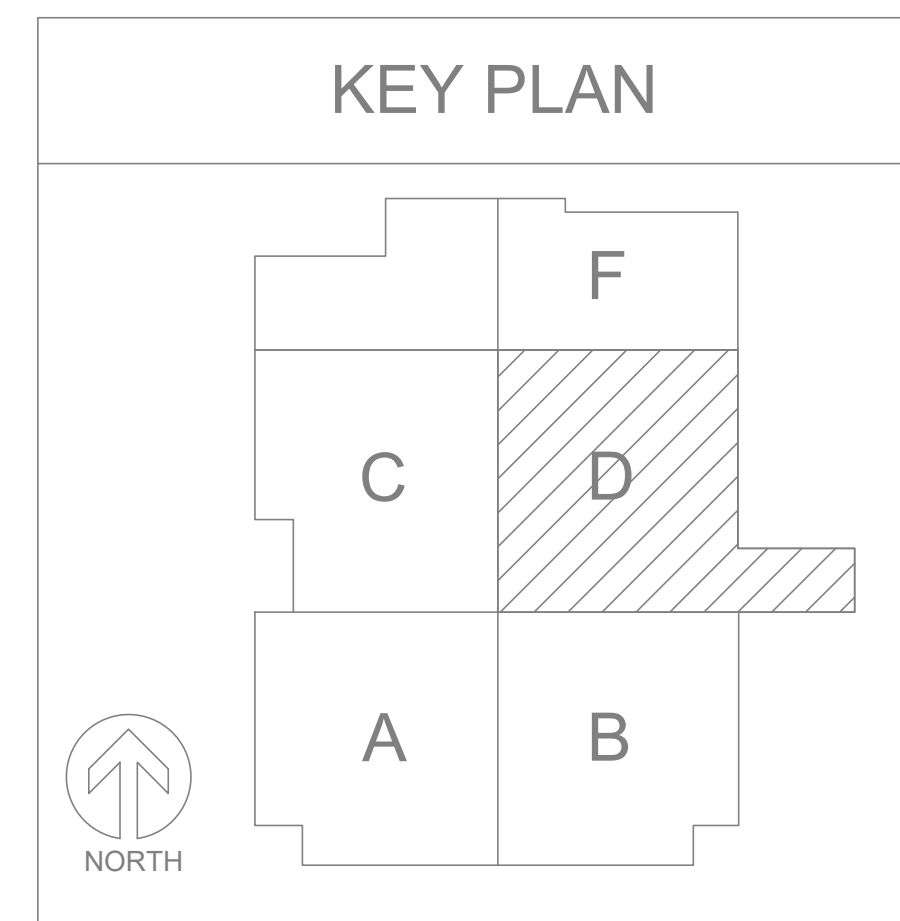
PD1.02C

100% BID AND PERMIT



PLUMBING DEMOLITION NOTES:

1. EXISTING GAS PIPING TO REMAIN AND BE REUSED.
2. EXISTING GAS METER AND REGULATOR ASSEMBLY TO REMAIN AND BE REUSED, LOCATED ON THE NORTHEAST CORNER OF THE BUILDING.
3. REMOVE GAS DROP, SUPPORTS, ACCESSORIES AND CONNECTION TO DEMO'D INFRARED HEATER. FIELD VERIFY EXIST LOCATION AND ROUTING. SEE HVAC DRAWINGS FOR MORE INFORMATION. DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER.
4. ADD ALTERNATE 1: REMOVE GAS PIPING, HANGERS AND ACCESSORIES BACK TO AS CLOSE TO THE MAIN AS POSSIBLE OR AS INDICATED ON DRAWINGS. FIELD VERIFY EXACT LOCATION. BASE BID: DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER. ABANDON PIPING IN PLACE. LABEL PIPING ABANDONED IN PLACE.
5. REMOVE EXISTING GENERATOR GAS BRANCH PIPING TO PENETRATION OF EXTERIOR WALL AND CAP PIPE FOR RECONNECTION UNDER NEW WORK. COORDINATE ANY SHUT-DOWN OF THE EMERGENCY GENERATOR WITH THE OWNER'S REPRESENTATIVE AND ALL OTHER TRADES. CONTRACTOR TO PATCH EXTERIOR WALL PENETRATION, SEE ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.

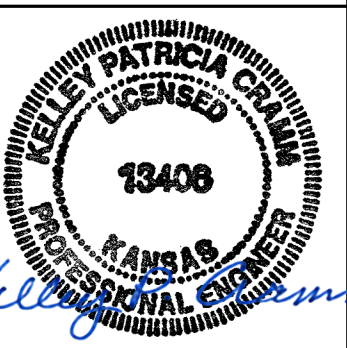


1 PLUMBING DEMOLITION PLAN LEVEL 2 - AREA D
SCALE: 1/8"=1'-0"

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LENEVA, KS 66214
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STATE LICENSE NUMBER: E-325
KS CORPORATION NUMBER: 1239141

PITTSBURG STATE UNIVERSITY
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1701 S BROADWAY ST
PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY: HEI



06/02/2021

PLUMBING DEMO FLOOR PLAN

A-014285

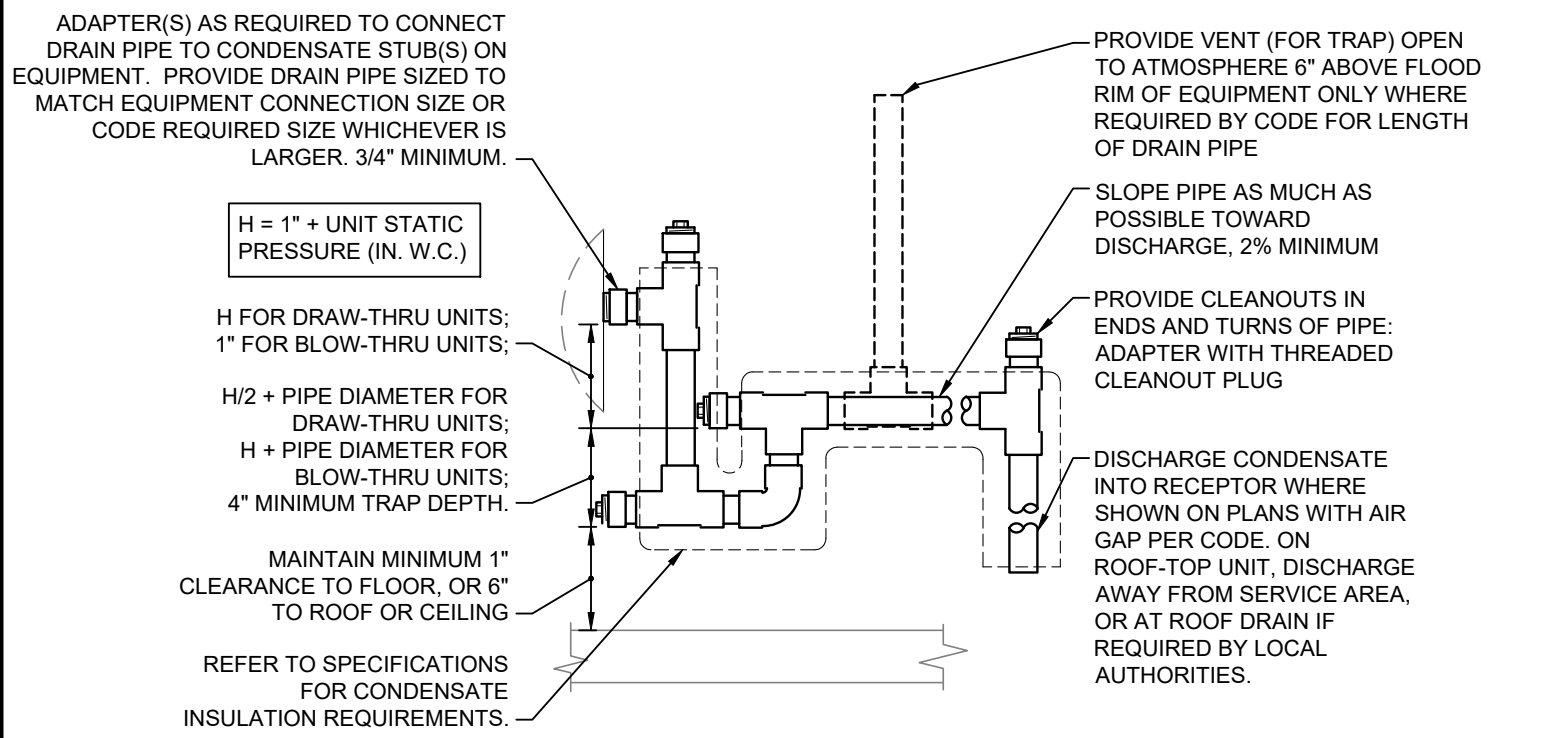
PD1.02D

100% BID AND PERMIT

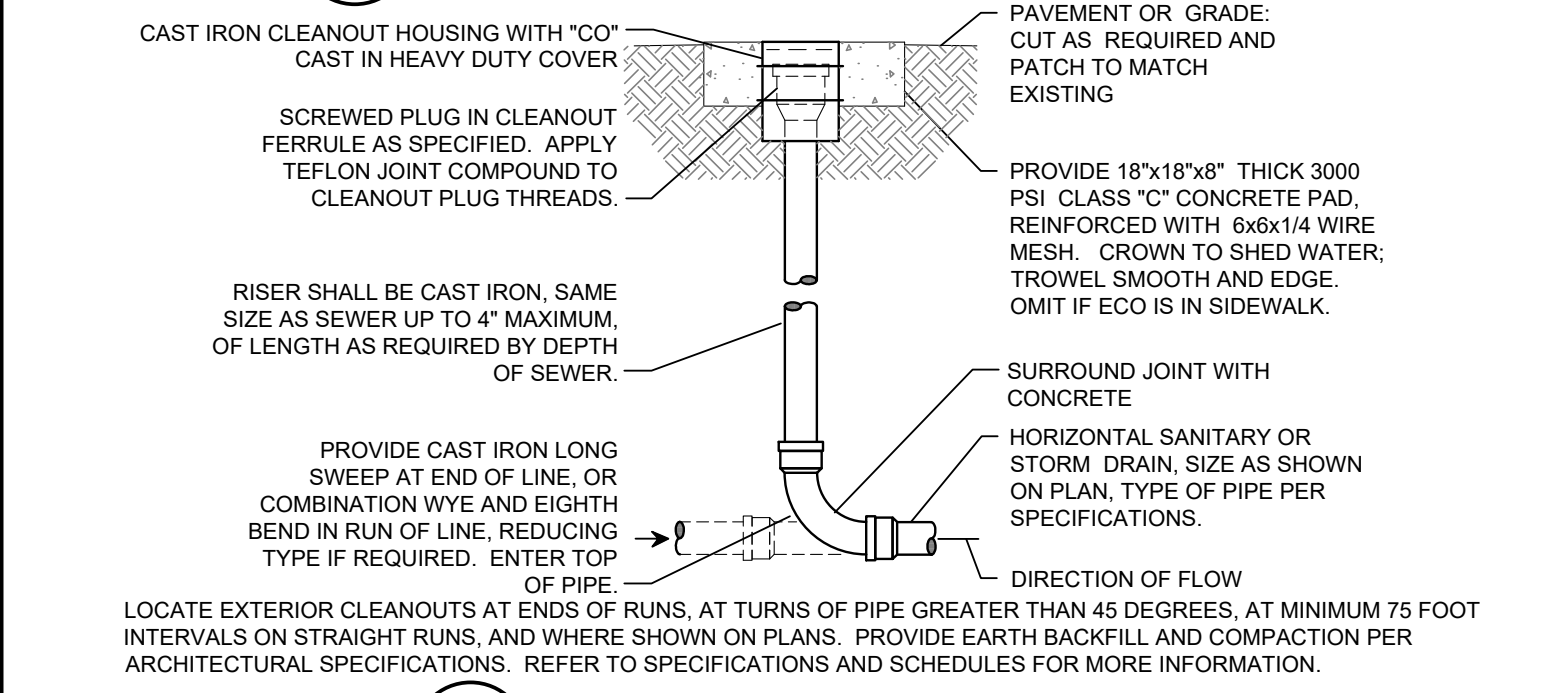
KELLEY P. CRAMM

GENERAL DEMOLITION NOTES:

- 1. PRIOR TO SUBMITTING BID, VISIT THE JOB SITE AND BECOME FULLY ACQUAINTED WITH THE EXISTING CONDITIONS OF THE PROJECT. REVIEW THE GENERAL NOTES, SPECIFICATIONS AND OTHER DRAWINGS FOR ADDITIONAL REQUIREMENTS WHICH MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY ARCHITECT OF CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID.
2. EXISTING CONDITIONS WERE TAKEN FROM ORIGINAL DRAWINGS AND SITE VISITS AND MAY NOT REFLECT EXACT "AS-BUILT" CONDITIONS. FIELD VERIFY EXISTING CONDITIONS PRIOR TO SUBMITTING FINAL BIDS. COORDINATE NEW WORK AND DEMOLITION WITH OTHER DISCIPLINES AND EXISTING CONDITIONS PRIOR TO CONSTRUCTION.
3. OWNER RETAINS RIGHTS OF SALVAGE FOR EQUIPMENT AND FIXTURES TO BE REMOVED. COORDINATE WITH THE OWNER THE EQUIPMENT AND FIXTURES TO BE SALVAGED AND THE LOCATION FOR STORAGE. AVOID DAMAGE TO EQUIPMENT, FIXTURES AND DEVICES DURING DEMOLITION WORK AND DURING TRANSPORT TO OWNER'S DESIGNATED STORAGE LOCATION.
4. REMOVE ITEMS SHOWN HEAVY LINED AND/OR CROSSHATCHED AND/OR NOTED TO BE REMOVED.
5. AVOID DAMAGING EXISTING SURFACES AND EQUIPMENT TO REMAIN FOR NEW INSTALLATION. REPAIR ANY DAMAGE CAUSED DURING WORK AT NO EXTRA COST TO THE OWNER.
6. SEAL ALL PENETRATIONS THROUGH FLOORS, WALLS, CEILINGS AND ROOFS WHERE PLUMBING COMPONENTS ARE REMOVED AND WHERE THE EXISTING PENETRATION IS NOT USED FOR THE NEW INSTALLATION. REPAIR SURFACES TO MATCH ADJACENT AREAS.
7. INSTALL PERMANENT CAPS WHERE PIPING IS REMOVED AND THE EXISTING TAPS ARE NOT USED FOR THE NEW INSTALLATION. INSTALL TEMPORARY CAPS WHERE PIPING IS REMOVED AND THE EXISTING TAPS WILL BE USED FOR THE NEW INSTALLATION TO PROTECT THE INTERIOR SURFACES UNTIL NEW PIPING IS INSTALLED.
8. REMOVE PIPE HANGERS, PIPE SUPPORTS AND EQUIPMENT SUPPORTS WHERE PIPING OR EQUIPMENT IS REMOVED AND THE EXISTING HANGERS AND SUPPORTS ARE NOT USED FOR THE NEW INSTALLATION.
9. VERIFY THAT EXISTING EQUIPMENT TO REMAIN IS OPERATING PROPERLY. NOTIFY THE ARCHITECT OF ANY DAMAGED AND/OR MALFUNCTIONING COMPONENTS.
10. WHERE SHUTDOWN OF EXISTING ACTIVE PIPING SYSTEMS IS REQUIRED DURING DEMOLITION PHASE OF WORK IN PREPARATION FOR NEW TIE-IN PHASE OF WORK, COORDINATE WITH THE OWNER AND MINIMIZE DOWNTIME. VERIFY EXISTING SYSTEMS, EQUIPMENT, AND COMPONENTS WILL BE PROVIDED WITH BACKUP SERVICE WHERE REQUIRED. NOTIFY OWNER A MINIMUM OF SEVEN (7) DAYS PRIOR TO INTERRUPTION OF SERVICE.



1 CONDENSATE DRAIN INSTALLATION NO SCALE



2 EXTERIOR CLEANOUT NO SCALE

GAS PRESSURE REGULATOR 2PSI SCHEDULE

Table with columns: MARK, MANUFACTURER, MODEL, VALVE TYPE, VALVE BODY SIZE (INCHES), MAX FLOW RATE (CFH), INLET PRESSURE (PSI), OUTLET PRESSURE (INCHES WATER COLUMN), SERVICE, NOTES.

NOTES:
A. C = SELF CONTAINED "DIRECT ACTING" DIAPHRAGM TYPE WITH INTERNAL VENT LIMITER
B. DROOP = 1" WATER COLUMN MAXIMUM
C. DROOP = 2" WATER COLUMN MAXIMUM
D. #5# ALUMINUM BODY, SCREWED CONNECTIONS AND OVERPRESSURE PROTECTION TO 25 PSI
E. MAXIMUM FLOWRATE SCHEDULED, MATCH BODY SIZE AND MAXIMUM FLOWRATE TO EQUIPMENT FLOWRATE. REFER TO EQUIPMENT SHOP DRAWINGS FOR EXACT LOADS.
F. LISTED TO MEET ANSI Z21.80 / CSA 6.22 WITH CSA LISTING STAMP ON REGULATOR BODY
G. GAS PRESSURE REGULATOR INLET PRESSURE = OPERATING PRESSURE - DESIGN FRICTION LOSS
H. 2 PSI MAXIMUM INLET PRESSURE AND 1 PSI MINIMUM INLET PRESSURE
I. PROVIDE EXTERNAL VENT LIMITER (WHERE APPROVED BY LOCAL AUTHORITIES) FOR INDOOR INSTALLATION AND INSTALL PER SPECIFICATIONS. INSTALL OUTDOORS PER SPECIFICATIONS.

GENERAL NOTES:

- 1. PROVIDE A CONSTRUCTION RECORD SET OF "AS-BUILT" DOCUMENTS TO THE ARCHITECT REFLECTING ANY VARIANCES OF INSTALLED PIPING LOCATIONS OR EQUIPMENT CONTRARY TO THE CONSTRUCTION DOCUMENTS, REFER TO SPECIFICATIONS.
2. DRAWINGS ARE DIAGRAMMATIC ONLY AND REPRESENT THE GENERAL SCOPE OF THE WORK. REVIEW THE GENERAL NOTES, SPECIFICATIONS AND PLANS FOR ADDITIONAL REQUIREMENTS THAT MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY THE ARCHITECT OF ANY CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID.
3. DRAWINGS ARE DIAGRAMMATIC ONLY AND REPRESENT THE GENERAL SCOPE OF THE WORK. PRIOR TO SUBMITTING BID, VISIT THE JOB SITE TO OBSERVE THE EXISTING CONDITIONS OF THE PROJECT. REVIEW THE GENERAL NOTES, SPECIFICATIONS AND PLANS FOR ADDITIONAL REQUIREMENTS THAT MAY NOT BE SPECIFICALLY CALLED OUT IN THIS PORTION OF THE CONSTRUCTION DOCUMENTS. NOTIFY ARCHITECT OF ANY CONFLICTS OR DISCREPANCIES PRIOR TO SUBMISSION OF BID.
4. PROVIDE TO THE ARCHITECT A COPY OF INSPECTION REPORTS AND APPROVAL CERTIFICATES FROM LOCAL AND STATE INSPECTIONS, REFER TO SPECIFICATIONS.
5. INSTALLATION SHALL COMPLY WITH LEGALLY CONSTITUTED CODES AND THE REQUIREMENTS OF AUTHORITIES HAVING JURISDICTION AND ALSO MEET ALL REQUIREMENTS OF THE LANDLORD. OBTAIN A COPY OF THE LANDLORD'S REQUIREMENTS AND REVIEW PRIOR TO SUBMITTING BID.
6. PLANS AND SPECIFICATIONS GOVERN WHERE THEY EXCEED CODE REQUIREMENTS.
7. VERIFY LOCATION AND DEPTH OF UTILITIES AT POINTS OF CONNECTION BEFORE START OF PIPING INSTALLATION.
8. REFER TO ARCHITECTURAL PLANS FOR EXACT LOCATION AND MOUNTING HEIGHTS OF PLUMBING FIXTURES.
9. DO NOT SCALE FLOOR PLANS FOR EXACT HORIZONTAL LOCATION OF PIPE ROUTING.
10. INSTALL CONCEALED PIPING TIGHT TO THE STRUCTURE AND AS HIGH AS POSSIBLE.
11. VALVES SHALL BE LINE SIZE UNLESS OTHERWISE NOTED.
12. INSTALL EXPOSED PIPING, WHERE NECESSARY, IN FINISHED AREAS TIGHT TO THE STRUCTURE, WALL OR CEILING AND AS HIGH AS POSSIBLE. INSTALL PIPING PARALLEL AND / OR PERPENDICULAR TO WALLS.
13. INSTALL VALVES AND APPURTENANCES A MAXIMUM OF 24" ABOVE CEILING IN ACCESSIBLE LOCATION WITHIN 24" OF ACCESS DOORS OR ACCESSIBLE CEILING TILES. PROVIDE PIPE AND FITTINGS TO INSTALL VALVES AND APPURTENANCES AT REQUIRED HEIGHT AND WITHIN 24" OF ACCESS DOORS OR ACCESSIBLE CEILING TILES.
14. COORDINATE ALL WORK WITH OTHER TRADES AND CONTRACTORS.
15. COORDINATE PIPING INSTALLATION WITH STRUCTURAL GRADE BEAMS, FOOTINGS, COLUMN PIERS, ETC. SLEEVE PIPING THROUGH GRADE BEAMS, FOOTING, ETC. WHERE REQUIRED AND AS NOTED ON PLANS. COORDINATE SLEEVE INSTALLATIONS WITH THE ARCHITECT, STRUCTURAL ENGINEER, STRUCTURAL CONTRACTOR AND GENERAL CONTRACTOR BEFORE CONCRETE IS INSTALLED.
16. CLEAN FAUCET AERATORS AND PIPE STRAINERS PRIOR TO TURNING BUILDING OVER TO THE OWNER.
17. PROVIDE TRAP PRIMERS WHERE REQUIRED BY LOCAL AUTHORITIES.
18. COORDINATE PIPE ROUTING AWAY FROM ELECTRICAL PANELS. DO NOT INSTALL PIPING OVER ELECTRICAL PANELS.
19. PAINT ALL EXPOSED GAS AND WATER PIPING USING RUST INHIBITOR PAINT. PAINT AND COLOR SHALL BE COORDINATED WITH THE ARCHITECT AND / OR OWNER.
20. COORDINATE ALL ROOF PENETRATIONS WITH OTHER TRADES. MAINTAIN 10' MINIMUM CLEARANCE FROM ALL AIR INTAKES. MAINTAIN 2' CLEARANCE FROM ALL OTHER EQUIPMENT.
21. INSULATE PIPING ROUTED IN EXTERIOR BUILDING WALLS WITH MINIMUM 2" BATT INSULATION TO PREVENT FREEZING.
22. PROVIDE TRANSITION ADAPTER COUPLINGS FOR CONNECTION OF PVC DWV TO CAST IRON AT SLAB ON GRADE. SEE DIVISION 22 SPECIFICATION FOR MORE INFORMATION.
23. PROVIDE TRANSITION ADAPTER COUPLINGS FOR CONNECTION OF PVC DWV TO CAST IRON SANITARY, WASTE AND VENT PIPE AT SLAB ON GRADE. SEE DIVISION 22 SPECIFICATION SECTION "SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES" FOR MORE INFORMATION.
24. PROVIDE TRANSITION ADAPTER COUPLINGS FOR CONNECTION OF PVC DWV TO CAST IRON STORM PIPE AT SLAB ON GRADE. SEE DIVISION 22 SPECIFICATION SECTION "STORM DRAINAGE PIPING AND SPECIALTIES" FOR MORE INFORMATION.
25. WATER HAMMER ARRESTORS SHALL BE SIZE "A" UNLESS NOTED OTHERWISE.
26. PROVIDE WALL PIPES AT PIPING PENETRATIONS OF ELEVATED WATERPROOF FLOOR SLABS, REFER TO SPECIFICATIONS.
27. VERIFY EXISTING EQUIPMENT, INCLUDING ACCESSORIES, IS NOT DAMAGED AND IS IN GOOD WORKING ORDER. REPORT ANY DEFICIENCIES TO THE ARCHITECT

PLUMBING SYMBOLS

THIS IS A MASTER LEGEND AND NOT ALL SYMBOLS OR ABBREVIATIONS ARE USED.
STANDARD MOUNTING HEIGHTS
CLINIC SERVICE SINKS (RIM) 30"
HOSE BIBB (CENTERLINE) 36"
ICE MAKER OUTLET BOX (CENTER OF BOX) 24"
JANITOR'S SINK FAUCET FITTINGS (CENTERLINE) 42"
LAVATORY OR SINK STANDARD HEIGHT (RIM) 31"
ADA ACCESSIBLE (RIM) 34"
CHILD HEIGHT (RIM) 24"
NON FREEZE WALL HYDRANT (AFG TO CENTERLINE) 18"
SHOWER HEAD MEN (CENTERLINE) 78"
WOMEN (CENTERLINE) 72"
SHOWER VALVE STANDARD HEIGHT - MEN (CENTERLINE) 48"
STANDARD HEIGHT - WOMEN (CENTERLINE) 42"
ADA ACCESSIBLE (CENTERLINE) 38" TO 48"
SURGEON'S SCRUB-UP SINK (FRONT RIM) 35"
TUB VALVE STANDARD HEIGHT (CENTERLINE) 32"
ADA ACCESSIBLE CENTER BETWEEN GRAB BAR AND TUB RIM
URINAL STANDARD HEIGHT (RIM) 24"
ADA ACCESSIBLE (RIM) 17"
CHILD HEIGHT (RIM) 14"
WASHING MACHINE OUTLET BOX (RIM) 42"
WATER CLOSET STANDARD HEIGHT (RIM) 15"
ADA ACCESSIBLE (TOP OF SEAT) 17" TO 19"
CHILD HEIGHT (RIM) 10"
WATER COOLER OR DRINKING FOUNTAIN STANDARD HEIGHT (SPOUT) 41"
ADA ACCESSIBLE (SPOUT) 36"
CHILD HEIGHT (SPOUT) 30"
INSTALL PLUMBING FIXTURES AT THE MOUNTING HEIGHTS SHOWN ABOVE UNO IN THE ARCHITECTURAL DRAWINGS OR ELSEWHERE IN THE CONSTRUCTION DOCUMENTS. FINAL APPROVAL OF LOCATIONS BY ARCHITECT. MOUNTING HEIGHTS LISTED ABOVE, OR ELSEWHERE IN THE CONSTRUCTION DOCUMENTS, ARE AFF. UNO. ALL DEVICES SHALL BE INSTALLED IN COMPLIANCE WITH CURRENT ADA AND LOCAL REQUIREMENTS.
ANNOTATION
1 PLUMBING PLAN NOTE CALLOUT
1 PLUMBING EQUIPMENT DESIGNATION. (CONTRACTOR FURNISHED AND INSTALLED), REFER TO PLUMBING FIXTURE OR EQUIPMENT SCHEDULES
1 EQUIPMENT DESIGNATION (OWNER FURNISHED, CONTRACTOR INSTALLED)
CU MECHANICAL EQUIPMENT DESIGNATION (CONTRACTOR PROVIDED UNO)
CONNECTION POINT OF NEW WORK TO EXISTING
1/PI DETAIL REFERENCE UPPER NUMBER INDICATES DETAIL NUMBER LOWER NUMBER INDICATES SHEET NUMBER
1/PI SECTION CUT DESIGNATION
ABBREVIATIONS
AFF ABOVE FINISHED FLOOR
AFG ABOVE FINISHED GRADE
AHU AIR HANDLING UNIT
AP ACCESS PANEL
BAS BUILDING AUTOMATION SYSTEM
BFF BELOW FINISHED FLOOR
BFG BELOW FINISHED GRADE
BOP BOTTOM OF PIPE
BOS BOTTOM OF STRUCTURE
BTU BRITISH THERMAL UNIT
CPV CONDENSATE PUMP
CPVC CHLORINATED POLYVINYL CHLORIDE
CU COPPER
DI DUCTILE IRON
DN DOWN
DFU DRAINAGE FIXTURE UNIT
DS DOWNSPOUT
(E) EXISTING
EMS ENERGY MANAGEMENT SYSTEM
ETR EXISTING TO REMAIN
EWC ELECTRIC WATER COOLER
FFA FLOOR DRAIN
FFA FROM FLOOR ABOVE
FFB FROM FLOOR BELOW
FFI FINISHED FLOOR
FL FLOOR LINE
FLA FULL LOAD AMPS
FLR FLOOR
GPM GALLONS PER MINUTE
HD HEAD, HUB DRAIN
IE INVERT ELEVATION
IN WC INCHES OF WATER COLUMN
JBU-BOX MAKE-UP AIR UNIT
MAX MAXIMUM
MBH 1000 BTU PER HOUR
MH MANHOLE
MIN MINIMUM
NIC NORMALLY CLOSED
NIO NORMALLY OPEN
NIC NOT IN CONTRACT
ORD OVERFLOW ROOF DRAIN
PDI PLUMBING DRAINAGE INSTITUTE
PH0 PHASE
PRV PRESSURE REDUCING VALVE
PVC POLYVINYL CHLORIDE
RCP REINFORCED CONCRETE PIPE
RD ROOF DRAIN
RPM REVOLUTIONS PER MINUTE
RTU ROOFTOP UNIT
SF SQUARE FEET
SP SUMP PUMP
SS STAINLESS STEEL, SANITARY SEWER, SOIL STACK
TDH TOTAL DYNAMIC HEAD
TFA TO FLOOR ABOVE
TFB TO FLOOR BELOW
TYP TYPICAL
UNO UNLESS NOTED OTHERWISE UNINTERRUPTIBLE POWER SUPPLY
VCP VITRIFIED CLAY PIPE
VFD VARIABLE FREQUENCY DRIVE
VS VENT STACK
VTR VENT THROUGH ROOF
WI WITH
WO WITHOUT
WC WATER COLUMN
WS WASTE STACK
WSFU WATER SUPPLY FIXTURE UNIT
LINETYPE LEGEND
THROUGHOUT THE DRAWINGS DIFFERENT LINE-TYPES ARE USED IN COMBINATION WITH THE SYMBOLS TO INDICATE THE STATUS OF ITEMS AS EXISTING, TO BE DEMOLISHED, TO BE INCLUDED AS PART OF NEW WORK AND/OR ITEMS WHICH ARE ANTICIPATED TO BE PROVIDED IN THE FUTURE. THE STATUS OF ITEMS USING THESE LINE-TYPES ARE RELATIVE TO THE VIEW IN WHICH THEY APPEAR. PHASING SHOWN IN DRAWINGS IS NOT INTENDED TO FULLY DESCRIBE ALL NECESSARY CONSTRUCTION PHASING, WHICH IS DETERMINED BY THE CONTRACTOR AS PART OF THEIR RESPONSIBILITIES. ANY SUCH PHASES DESCRIBED IN THE CONSTRUCTION DOCUMENTS ARE GENERAL AND ONLY INTENDED TO INDICATE A BROAD ORDER FOR THE SAKE OF DESCRIBING THE PROJECT. THE FOLLOWING LINE-TYPES MAY BE USED ON ANY DEVICE, EQUIPMENT, NOTE, LINE, SHAPE, ETC.
EXISTING _____ NEW _____
DEMOLISH - - - - - FUTURE - - - - -

NOTE:

THIS BUILDING HAS TWO SEPARATE NATURAL GAS SERVICES. SHUTTING OFF THE GAS AT ONE LOCATION WILL NOT SHUT OFF THE GAS SERVICE TO THE ENTIRE BUILDING. EACH GAS SERVICE MUST BE TURNED OFF FOR THE ENTIRE BUILDING TO BE OFF.

CONTRACTOR TO PROVIDE SIGNAGE AT BOTH GAS METER LOCATIONS

TOTAL CONNECTED NATURAL GAS LOAD

Table with columns: EQUIPMENT DESIGNATION, DESCRIPTION, CFH (EACH), TOTAL CONNECTED LOAD = 4114.8

MEDIUM PRESSURE GAS PIPE SIZING CHART

Table with columns: PIPE SIZE, LOAD (CFH), FOR SCHEDULE 40 STEEL PIPE, SPECIFIC GRAVITY OF GAS = 0.60, UPSTREAM PRESSURE (PSI) = 2, DOWNSTREAM PRESSURE (PSI) = 1, PRESSURE LOSS (PSI) = 1.0, TOTAL DEVELOPED LENGTH (FEET) = 320, BASED ON NFPA54 EQUATION 4-2

LOW PRESSURE GAS PIPE SIZING CHART

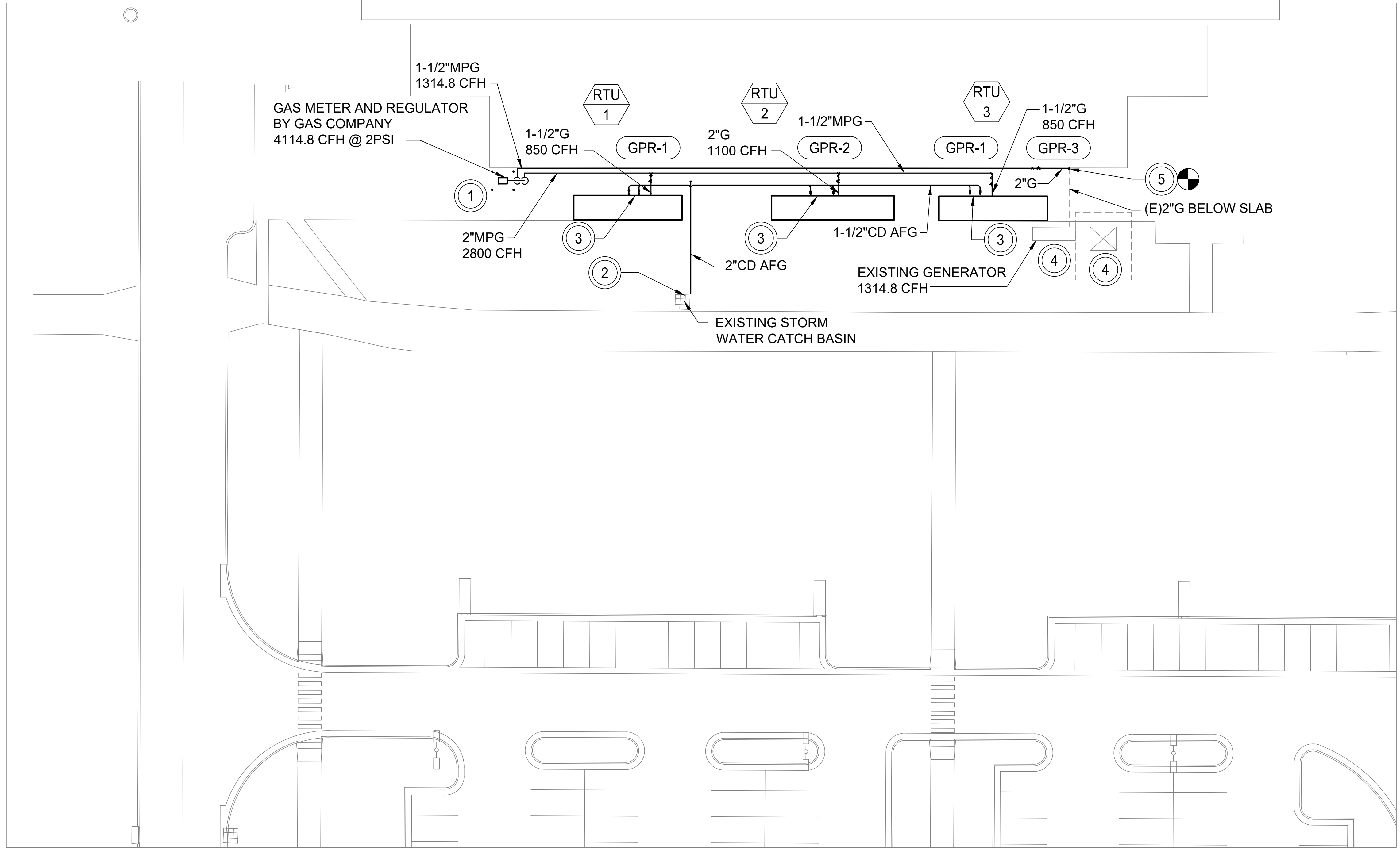
Table with columns: PIPE SIZE, LOAD (CFH), FOR SCHEDULE 40 STEEL PIPE, OPERATING PRESSURE OF 7"WC WITH A PRESSURE DROP OF 0.5"WC, TOTAL DEVELOPED LENGTH (FEET) = 35, BASED ON NFPA54 EQUATION 4-1

HENDERSON ENGINEERS logo and contact information: 8548 LENEWA DRIVE, SUITE 300, LENEWA, KS 66214, TEL 913.742.9000, FAX 913.742.9001, WWW.HENDERSONENGINEERS.COM, 2150001628, LICENSE NUMBER: E-325, 10/30/11, KS. CORP. REG. NUMBER: E-325

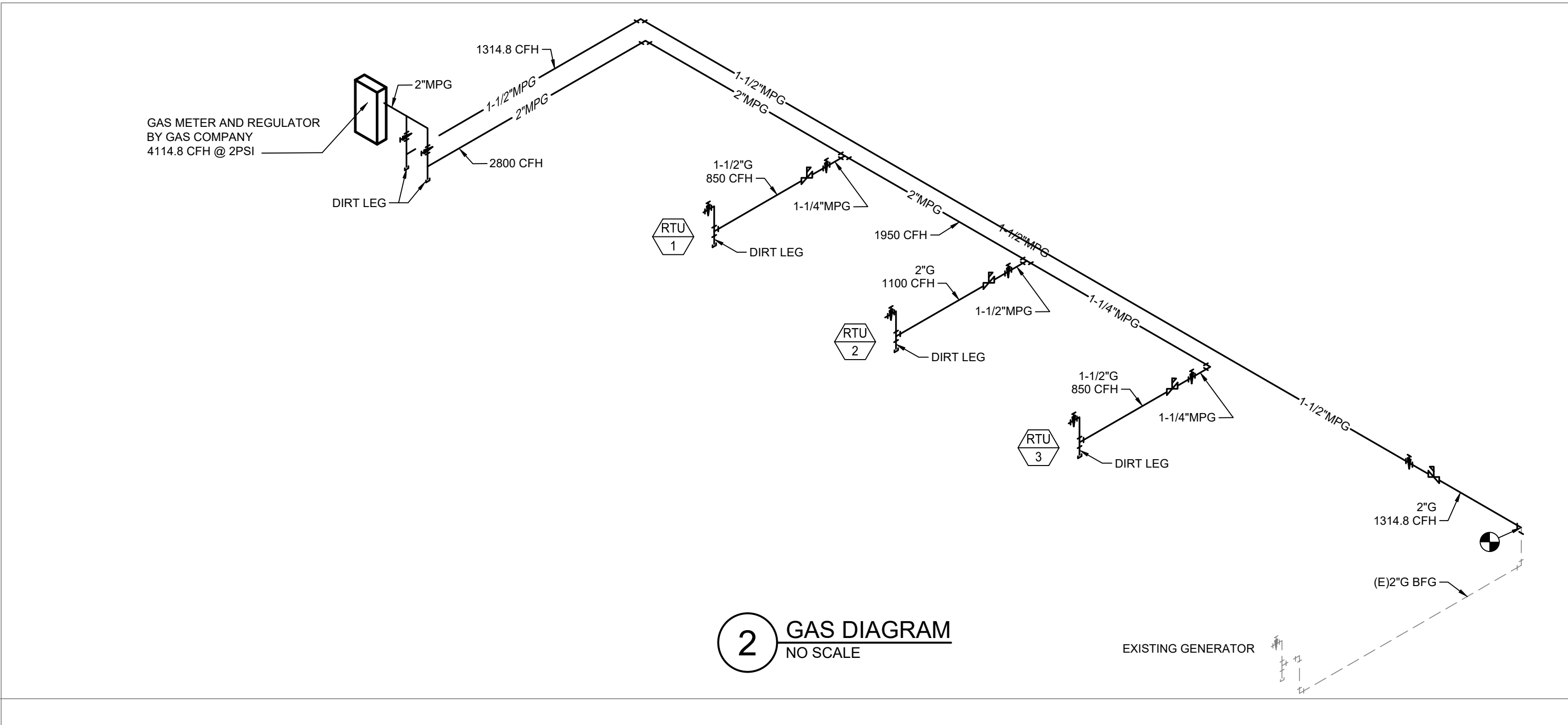
PITTSBURG STATE UNIVERSITY WEEDE FIELDHOUSE HVAC UPGRADES 1701 S BROADWAY ST PITTSBURG, KS DATE: 05-28-2021 DRAWN BY: HEI

KANSAS PROFESSIONAL ENGINEER 13406 logo

06/02/2021 PLUMBING GENERAL NOTES AND DETAILS A-014285 P0.00 100% BID AND PERMIT



1 PLUMBING SITE PLAN
SCALE: 1"= 20'



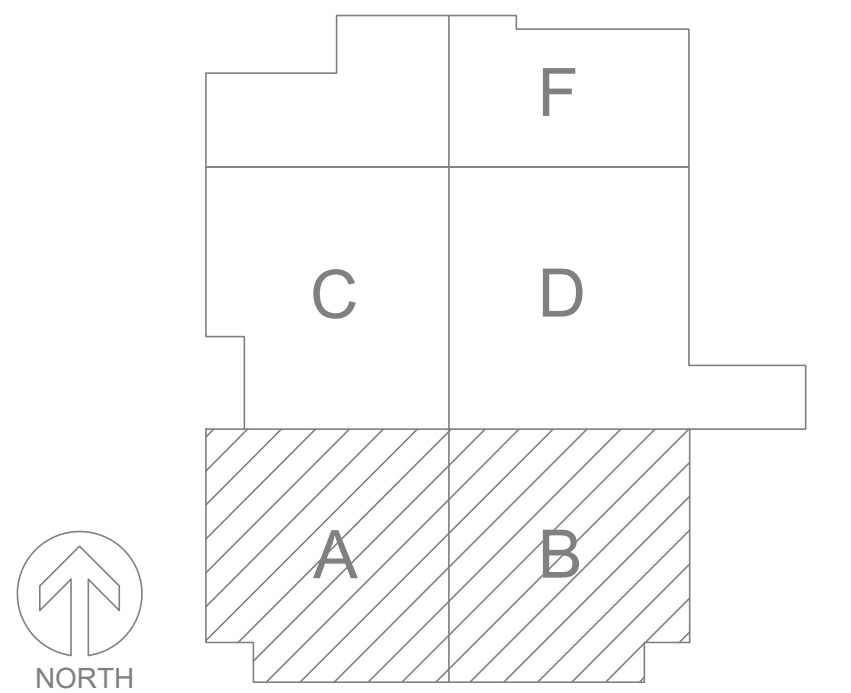
2 GAS DIAGRAM
NO SCALE

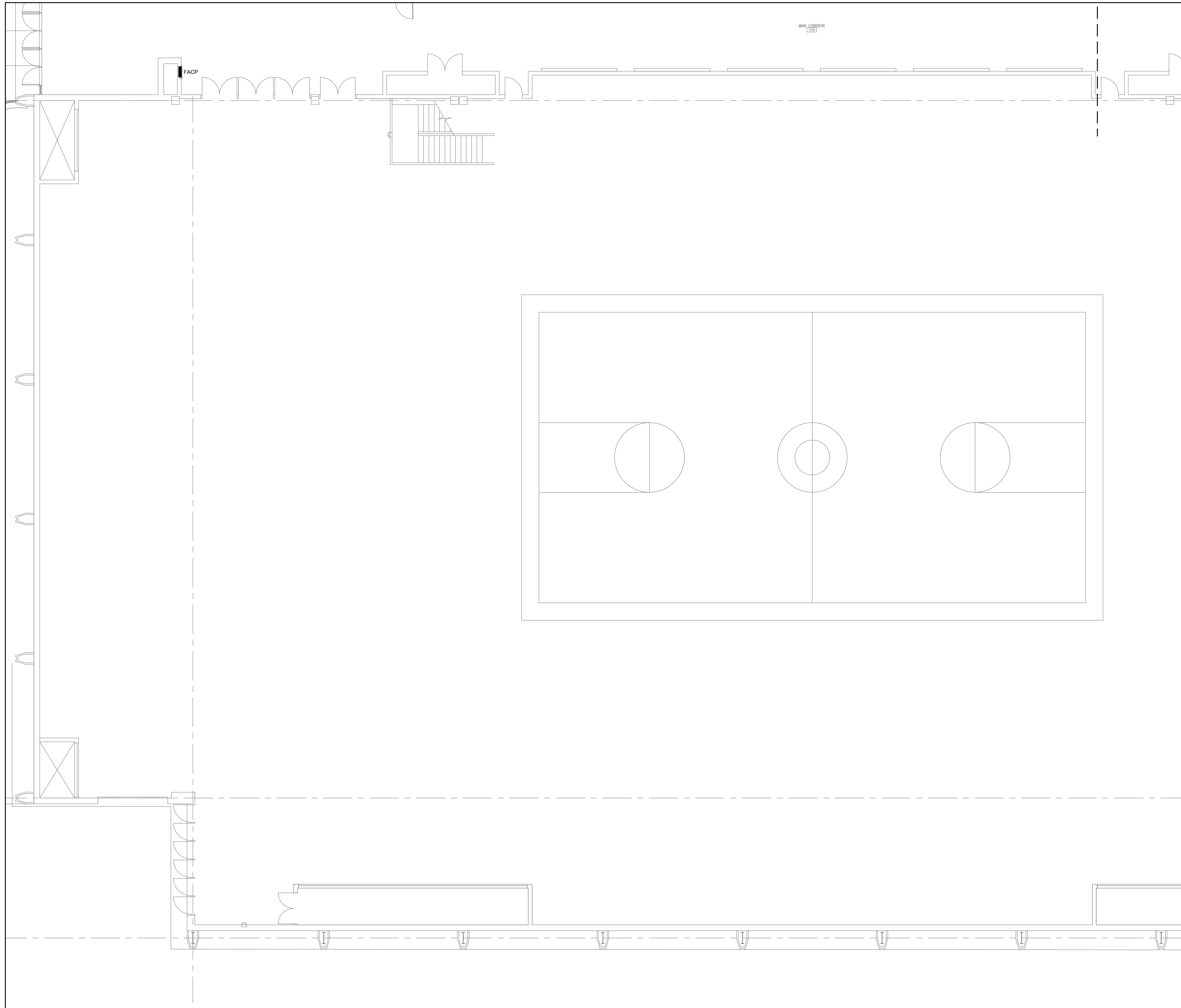
PLUMBING NOTES:

- COORDINATE INSTALLATION OF NEW GAS METER AND REGULATOR ASSEMBLY WITH THE LOCAL GAS SUPPLIER AND OWNER'S REPRESENTATIVE. SEE STRUCTURAL DRAWINGS FOR INFORMATION ON BOLLARDS.
- ROUTE 2" CONDENSATE DRAIN TO EXISTING STORM CATCH BASIN. TERMINATE WITH AIR GAP OVER BASIN. FIELD VERIFY EXACT LOCATION INCLUDING BUT NOT LIMITED TO INVERT ELEVATIONS.
- CONNECT TO HVAC UNIT CONDENSATE AND DRAIN PAN CONNECTIONS. TERMINATE OVER HUB DRAIN WITH AIR GAP.
- SEE ELECTRICAL DRAWINGS FOR MORE INFORMATION ON ELECTRICAL EQUIPMENT.
- CONNECT 2"G TO EXISTING 2"G JUST PRIOR TO THE EXISTING PIPING DROPPING BELOW GRADE. CONTRACTOR TO VERIFY PIPE SIZE, LOCATION AND THE GAS CONNECTION TO EXISTING GENERATOR IS COMPLETE.

EXISTING CONDITIONS NOTE:
EXISTING CONDITIONS WERE TAKEN FROM PREVIOUS CONSTRUCTION DRAWINGS AND MAY NOT REFLECT EXACT 'AS-BUILT' CONDITIONS. FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO SUBMITTING FINAL BIDS. CAREFULLY COORDINATE NEW WORK AND DEMOLITION WITH ALL OTHER DISCIPLINES AND EXISTING CONDITIONS AS REQUIRED.

KEY PLAN



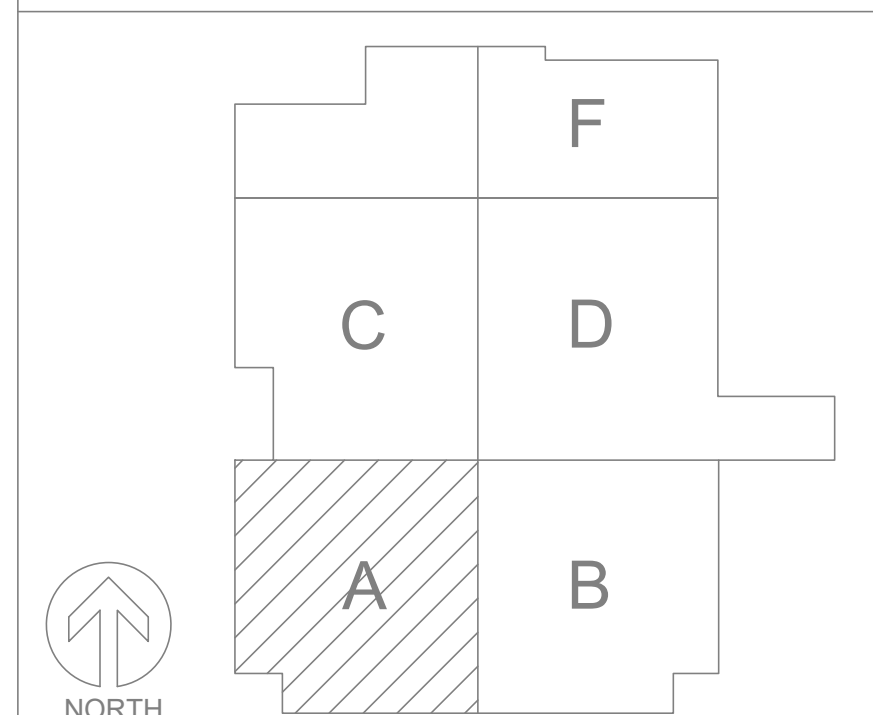


PLUMBING DEMOLITION NOTES:

1. EXISTING GAS PIPING TO REMAIN AND BE REUSED.
2. EXISTING GAS METER AND REGULATOR ASSEMBLY TO REMAIN AND BE REUSED.
3. REMOVE GAS DROP, SUPPORTS, ACCESSORIES AND CONNECTION TO DEMO'D INFRARED HEATER. FIELD VERIFY EXIST' LOCATION AND ROUTING. SEE HVAC DRAWINGS FOR MORE INFORMATION. DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER.
4. ADD ALTERNATE 1: REMOVE GAS PIPING, HANGERS AND ACCESSORIES BACK TO AS CLOSE TO THE MAIN AS POSSIBLE OR AS INDICATED ON DRAWINGS. FIELD VERIFY EXACT LOCATION BASE BID. DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER. ABANDON PIPING IN PLACE. LABEL PIPING ABANDONED IN PLACE.

EXISTING CONDITIONS NOTE:
 EXISTING CONDITIONS WERE TAKEN FROM PREVIOUS CONSTRUCTION DRAWINGS AND MAY NOT REFLECT EXACT 'AS-BUILT' CONDITIONS. FIELD VERIFY ALL EXISTING CONDITIONS PRIOR TO SUBMITTING FINAL BIDS. CAREFULLY COORDINATE NEW WORK AND DEMOLITION WITH ALL OTHER DISCIPLINES AND EXISTING CONDITIONS AS REQUIRED.

KEY PLAN



1 PLUMBING DEMOLITION PLAN LEVEL 1 - AREA A
 SCALE: 1/8"=1'-0"



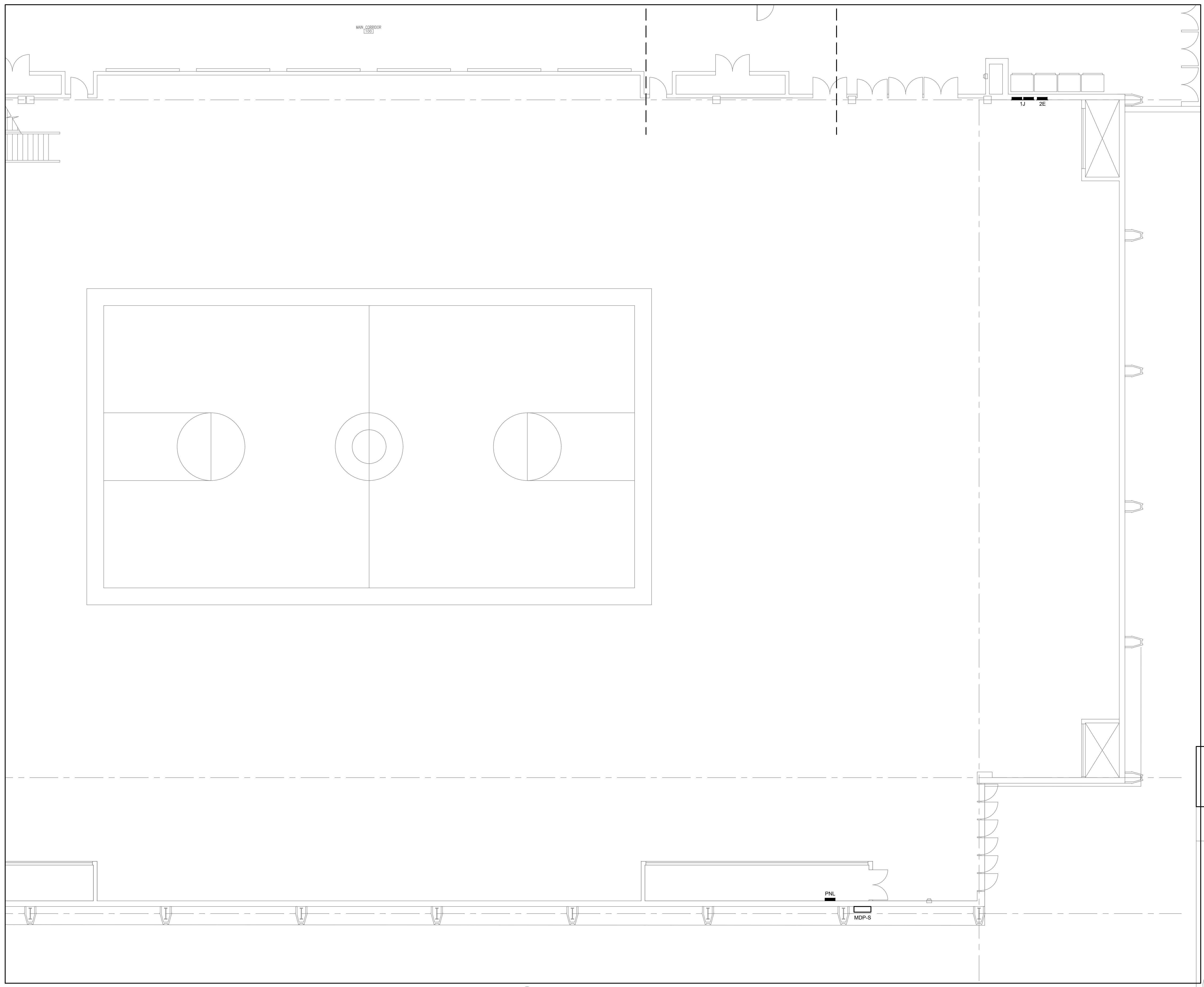
06/02/2021

PLUMBING DEMO FLOOR PLAN

A-014285

PD1.01A

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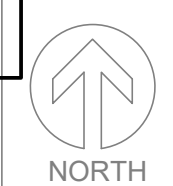
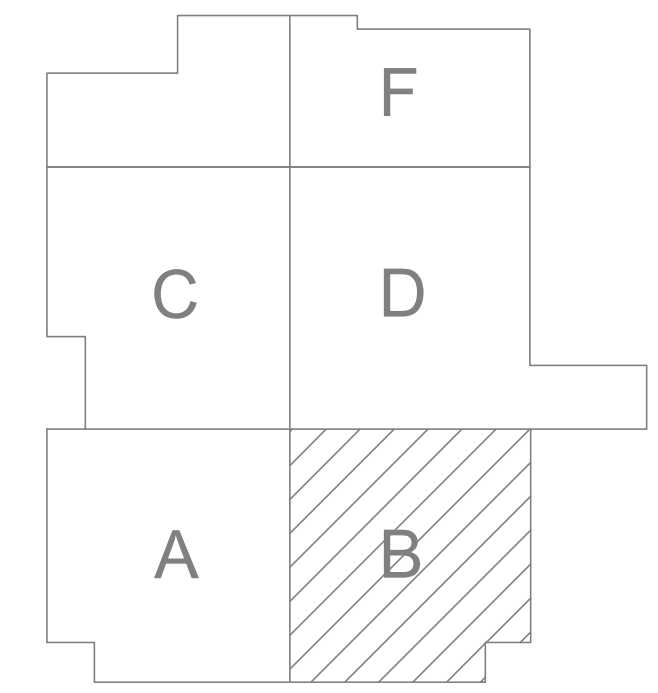


PLUMBING DEMOLITION NOTES:

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KEY PLAN

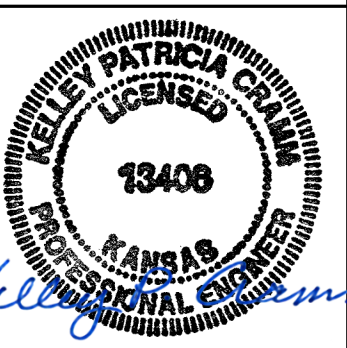


1 PLUMBING DEMOLITION PLAN LEVEL 1 - AREA B
 SCALE: 1/8"=1'-0"

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 8348 LENEVA DRIVE, SUITE 300
 LENEVA, KS 66214
 TEL 913.742.3000 FAX 913.742.9001
 WWW.HENDERSONENGINEERS.COM
 Z15001628
 KS CORPORATE LICENSE NUMBER: E-325
 12/31/21

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
 1701 S BROADWAY ST
 PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY: HEI



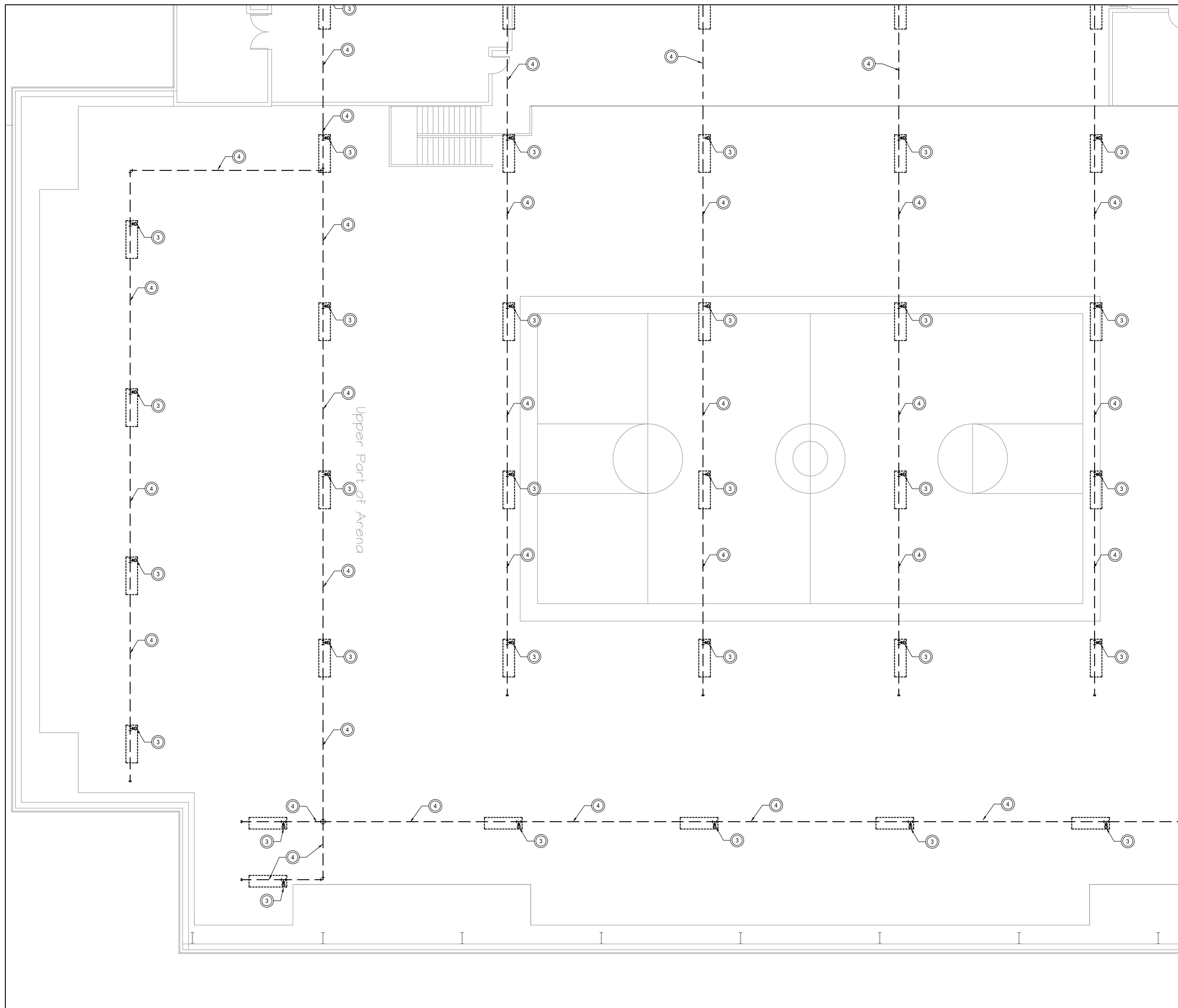
06/02/2021

PLUMBING DEMO FLOOR PLAN

A-014285

PD1.01B

100% BID AND PERMIT



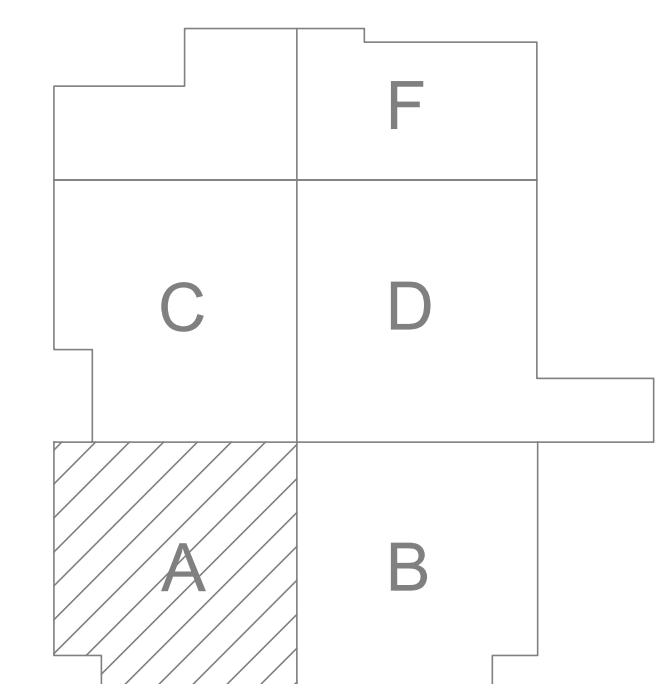
PLUMBING DEMOLITION NOTES:

1. EXISTING GAS PIPING TO REMAIN AND BE REUSED.
2. EXISTING GAS METER AND REGULATOR ASSEMBLY TO REMAIN AND BE REUSED, LOCATED ON THE NORTHEAST CORNER OF THE BUILDING.
3. REMOVE GAS DROP, SUPPORTS, ACCESSORIES AND CONNECTION TO DEMO'D INFRARED HEATER. FIELD VERIFY EXIST LOCATION AND ROUTING. SEE HVAC DRAWINGS FOR MORE INFORMATION. DISCONNECT AND MAKE SAFE CONNECTION TO INFRARED HEATER.
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5. REMOVE EXISTING GENERATOR GAS BRANCH PIPING TO PENETRATION OF EXTERIOR WALL AND CAP PIPE FOR RECONNECTION UNDER NEW WORK. COORDINATE ANY SHUT-DOWN OF THE EMERGENCY GENERATOR WITH THE OWNER'S REPRESENTATIVE AND ALL OTHER TRADES. CONTRACTOR TO PATCH EXTERIOR WALL PENETRATION. SEE ARCHITECTURAL DRAWINGS FOR MORE INFORMATION.

PITTSBURG STATE UNIVERSITY
WEEDE FIELDHOUSE HVAC UPGRADES
 1701 S BROADWAY ST
 PITTSBURG, KS

DATE: 05-28-2021 DRAWN BY: HEI

KEY PLAN



1 PLUMBING DEMOLITION PLAN LEVEL 2 - AREA A
 SCALE: 1/8"=1'-0"



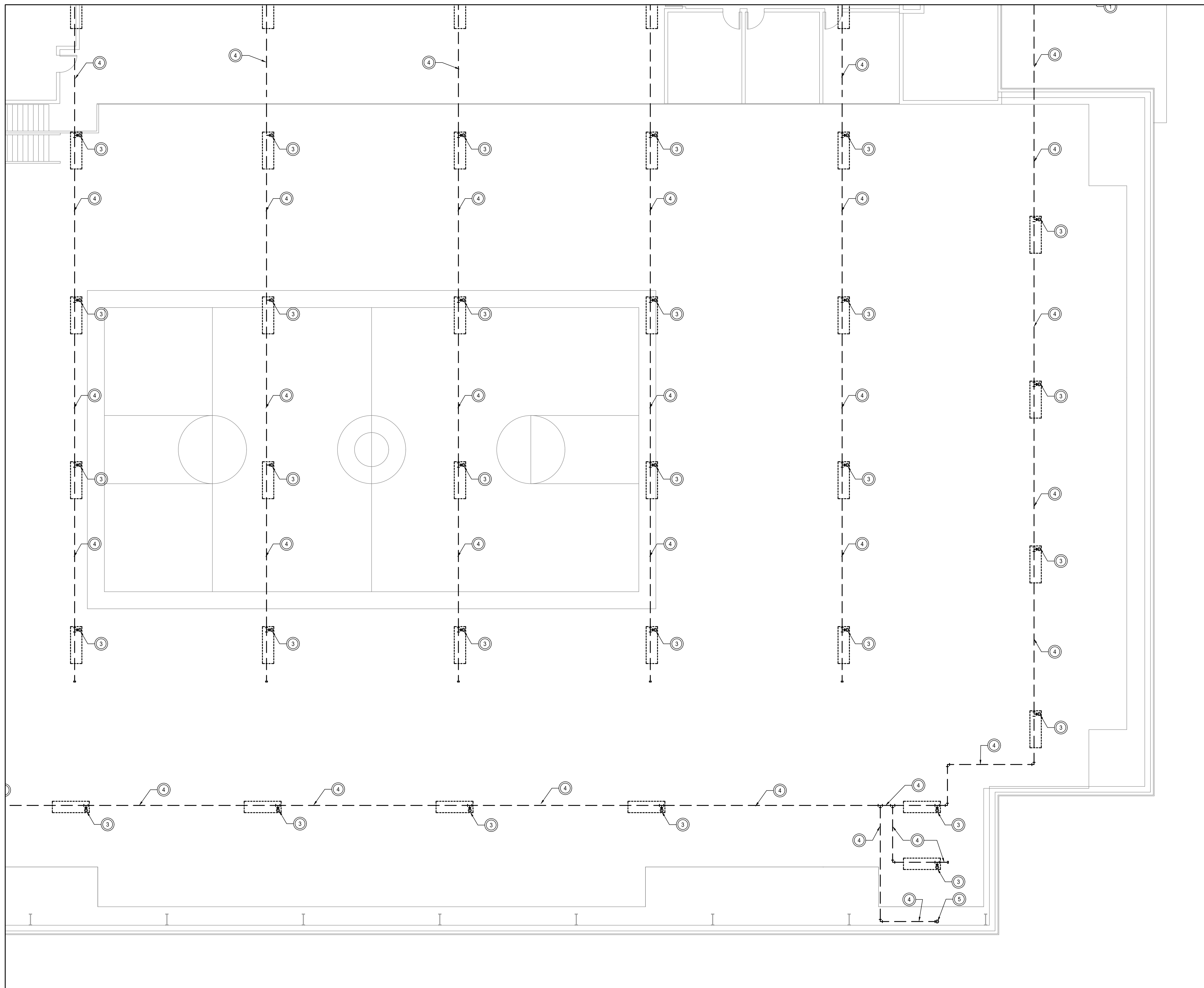
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PLUMBING DEMO FLOOR PLAN

A-014285

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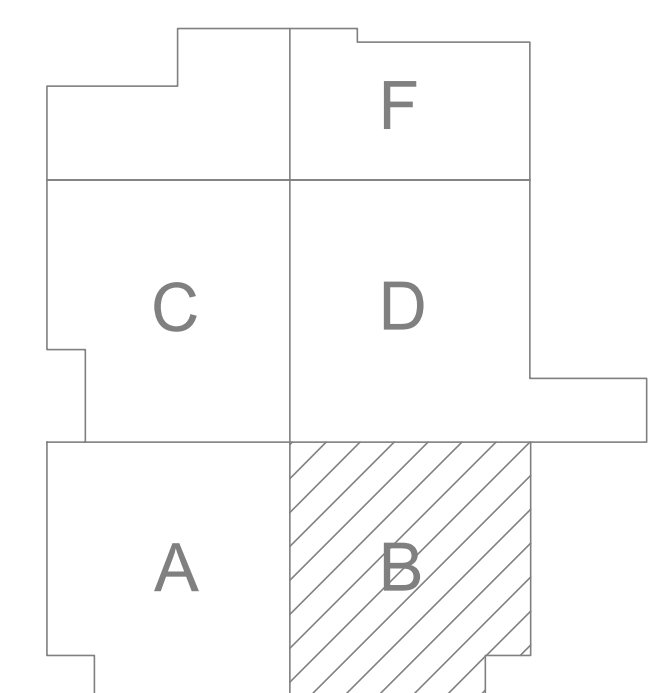
100% BID AND PERMIT



PLUMBING DEMOLITION NOTES:

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KEY PLAN

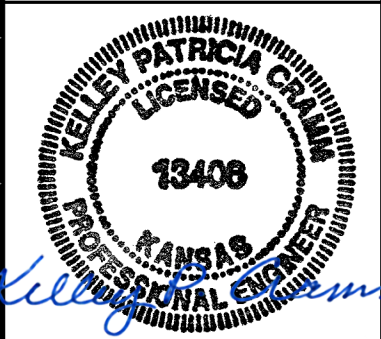


1 PLUMBING DEMOLITION PLAN LEVEL 2 - AREA B
SCALE: 1/8"=1'-0"

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8348 LENEXA DRIVE, SUITE 300
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PLUMBING DEMO FLOOR PLAN

A-014285

PD1.02B

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PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

233113 METAL DUCTS
233300 AIR DUCT ACCESSORIES
233413 AXIAL HVAC FANS
233713 DIFFUSERS, REGISTERS & GRILLES
237413 OUTDOOR PACKAGED HEATING AND COOLING UNITS

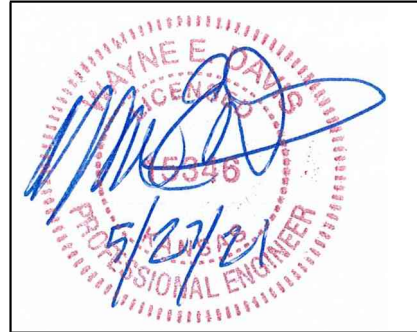
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262816 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

Specifications: Divisions 3 and 5
Drawings: Structural drawings

By:  _____

Wayne Davis, P.E.



MECHANICAL/PLUMBING

The documents intended to be authenticated by my seal are limited to:

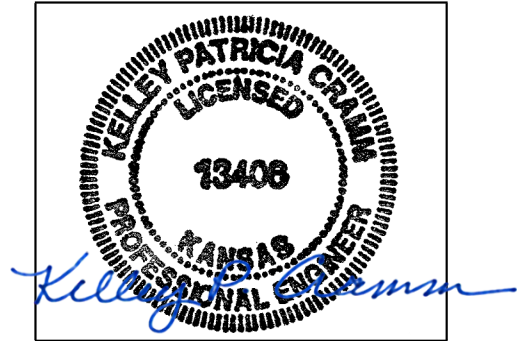
I hereby disclaim any responsibility for all other plans, specifications, estimates, reports or other documents or instruments relating to or intended to be used for any part of the project.

Specifications: Division 22 all Sections
Division 23 all Sections

Drawings: Mechanical and plumbing drawings

By: _____

Kelley Cramm, P.E.



06/01/2021

ELECTRICAL

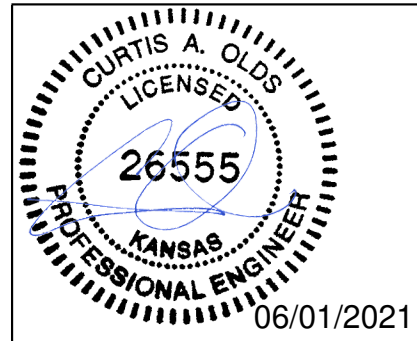
The documents intended to be authenticated by my seal are limited to:

I hereby disclaim any responsibility for all other plans, specifications, estimates, reports or other documents or instruments relating to or intended to be used for any part of the project.

Specifications: Division 26 all Sections
Drawings: Electrical Drawings

By: _____

Curtis Olds, P.E.



SECTION 012300

ALTERNATES

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 administrative and procedural requirements for alternates.

1.3 DEFINITIONS

- A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if the Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.
 - 1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
 - 2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternates into the Work. No other adjustments are made to the Contract Sum.

1.4 PROCEDURES

- A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.
 - 1. Include, as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation, whether or not indicated as part of alternate.
- B. Execute accepted alternates under the same conditions as other Work of the Contract.
- C. Schedule: A Part 3 "Schedule of Alternates" Article is included at the end of this Section. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF ALTERNATES

- A. Alternate No. 1: Demolition of Existing Gas Piping.
 - 1. Base Bid: Disconnect and make safe the existing gas piping to the demolished infrared unit heaters and make up air units, but abandon in place the gas piping."
 - 2. Alternate: Demolish the existing gas piping to the infrared unit heaters and make up air units to the north side of the field house as indicated on the Drawings.

END OF SECTION 012300

SECTION 012500

SUBSTITUTION PROCEDURES

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 administrative and procedural requirements for substitutions.
- B. Related Requirements:
 - 1. Document 002600 "Procurement Substitution Procedures" for requirements for substitution requests prior to award of Contract.
 - 2. Section 012300 "Alternates" for products selected under an alternate.
 - 3. Section 016000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.4 ACTION SUBMITTALS

- A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form provided in Project Manual.
 - 2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
 - 3. Engineers' Action: If necessary, Engineer will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within [5 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.7 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.

1. Conditions: Engineer will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with these requirements:
 - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
 - b. Substitution request is fully documented and properly submitted.
 - c. Requested substitution will not adversely affect Contractor's construction schedule.
 - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
 - e. Requested substitution is compatible with other portions of the Work.
 - f. Requested substitution has been coordinated with other portions of the Work.
 - g. Requested substitution provides specified warranty.
 - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

- B. Substitutions for Convenience: Not allowed.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012500

SECTION 012600

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 administrative and procedural requirements for handling and processing Contract modifications.
- B. Related Requirements:
 - 1. Section 012500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.
 - 2. Section 013100 "Project Management and Coordination" for requirements for forms for contract modifications provided as part of web-based Project management software.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Work Change Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.
 - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Engineer.
 - 3. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
 - a. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - b. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - c. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.

- d. Include costs of labor and supervision directly attributable to the change.
- e. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
- f. Comply with requirements in Section 012500 "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
- g. Proposal Request Form: Use form acceptable to Engineer.

1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 012100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.
- B. Unit-Price Adjustment: See Section 012200 "Unit Prices" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect measured scope of unit-price work.

1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Change Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Engineer may issue a Construction Change Directive. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.8 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive.. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
- C. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 012600

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

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 administrative provisions for coordinating construction operations on Project, including, but not limited to, the following:
 - 1. General coordination procedures.
 - 2. Coordination drawings.
 - 3. RFIs.
 - 4. Project meetings.
- B. Each contractor shall participate in coordination requirements. Certain areas of responsibility are assigned to a specific contractor.
- C. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for a description of the division of work among separate contracts and responsibility for coordination activities not in this Section.
 - 2. Section 017300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 3. Section 017700 "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. BIM: Building Information Modeling.
- B. RFI: Request for Information. Request from Owner, Engineer, or Contractor seeking information required by or clarifications of the Contract Documents.

1.4 INFORMATIONAL SUBMITTALS

- A. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
 - 1. Name, address, telephone number, and email address of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
- B. Key Personnel Names: Within 5 days of starting construction operations, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses, cellular telephone numbers, and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates in the absence of individuals assigned to Project.
 - 1. Post copies of list in Project meeting room, in temporary field office, and in prominent location in the facility. Keep list current at all times.

1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate

construction operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. Coordination of Multiple Contracts: Each contractor shall cooperate with Project coordinator, who shall coordinate its construction operations with those of other contractors and entities to ensure efficient and orderly installation of each part of the Work. Each contractor shall coordinate its own operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.
1. Schedule construction operations in sequence required to obtain the best results, where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
- C. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- D. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and scheduled activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
1. Preparation of Contractor's construction schedule.
 2. Preparation of the schedule of values.
 3. Installation and removal of temporary facilities and controls.
 4. Delivery and processing of submittals.
 5. Progress meetings.
 6. Preinstallation conferences.
 7. Project closeout activities.
 8. Startup and adjustment of systems.

1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely indicated on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
 - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.

- b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
 - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
 - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
 - e. Indicate required installation sequences.
 - f. Indicate dimensions shown on Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternative sketches to Engineer indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
- 1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
 - 2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
 - 3. Mechanical Rooms: Provide coordination drawings for mechanical rooms, showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
 - 4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
 - 5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
 - 6. Mechanical and Plumbing Work: Show the following:
 - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
 - b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
 - c. Fire-rated enclosures around ductwork.
 - 7. Electrical Work: Show the following:
 - a. Runs of vertical and horizontal conduit 1-1/4 inches (32 mm) in diameter and larger.
 - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
 - c. Panel board, switchboard, switchgear, transformer, busway, generator, and motor-control center locations.
 - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
 - 8. Review: Engineer will review coordination drawings to confirm that, in general, the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Engineer determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Engineer will so inform Contractor, who shall make suitable modifications and resubmit.
 - 9. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 013300 "Submittal Procedures."

- C. Coordination Drawing Process: Prepare coordination drawings in the following manner:
1. Schedule submittal and review of Fire Sprinkler, Plumbing, HVAC, and Electrical Shop Drawings to make required changes prior to preparation of coordination drawings.
 2. Commence routing of coordination drawing files with HVAC Installer, who will provide drawing plan files denoting approved ductwork. HVAC Installer will locate ductwork and piping on a single layer, using orange color. Forward drawings to Plumbing Installer.
 3. Plumbing Installer will locate plumbing and equipment on a single layer, using blue color.
 4. Fire Sprinkler Installer will locate piping and equipment, using red color. Fire Sprinkler Installer shall forward drawing files to Electrical Installer.
 5. Electrical Installer will indicate service and feeder conduit runs and equipment in green color. Electrical Installer shall forward drawing files to Communications and Electronic Safety and Security Installer.
 6. Communications and Electronic Safety and Security Installer will indicate cable trays and cabling runs and equipment in purple color. Communications and Electronic Safety and Security Installer shall forward completed drawing files to Contractor.
 7. Contractor shall perform the final coordination review. As each coordination drawing is completed, Contractor will meet with Engineer to review and resolve conflicts on the coordination drawings.

1.7 REQUEST FOR INFORMATION (RFI)

- A. General: Immediately on discovery of the need for additional information, clarification, or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
1. Engineer will return without response those RFIs submitted to Engineer by other entities controlled by Contractor.
 2. Coordinate and submit RFIs in a prompt manner to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name.
 2. Owner name.
 3. Owner's Project number.
 4. Name of Engineer
 5. Engineer's Project number.
 6. Date.
 7. Name of Contractor.
 8. RFI number, numbered sequentially.
 9. RFI subject.
 10. Specification Section number and title and related paragraphs, as appropriate.
 11. Drawing number and detail references, as appropriate.
 12. Field dimensions and conditions, as appropriate.
 13. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 14. Contractor's signature.
 15. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.

- a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
 - C. RFI Forms: Software-generated form with substantially the same content as indicated above, acceptable to Engineer.
 1. Attachments shall be electronic files in PDF format.
 - D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven days for Engineer's response for each RFI. RFIs received by engineer after 1:00 p.m. will be considered as received the following working day.
 1. The following Contractor-generated RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for approval of Contractor's means and methods.
 - d. Requests for coordination information already indicated in the Contract Documents.
 - e. Requests for adjustments in the Contract Time or the Contract Sum.
 - f. Requests for interpretation of Engineer's actions on submittals.
 - g. Incomplete RFIs or inaccurately prepared RFIs.
 2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt by Engineer [of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 012600 "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 5 days of receipt of the RFI response.
 - E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Software log with not less than the following:
 1. Project name.
 2. Name and address of Contractor.
 3. Name and address of Engineer's
 4. RFI number, including RFIs that were returned without action or withdrawn.
 5. RFI description.
 6. Date the RFI was submitted.
 7. Date Engineer's response was received.
 8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.
 9. Identification of related Field Order, Work Change Directive, and Proposal Request, as.
 - F. On receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven days if Contractor disagrees with response.

1.8 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences at Project site unless otherwise indicated.
 1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Engineer of scheduled meeting dates and times a minimum of seven days prior to meeting.
 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.

3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Engineer, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.
1. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Discuss items of significance that could affect progress, including the following:
 - a. Responsibilities and personnel assignments.
 - b. Tentative construction schedule.
 - c. Phasing.
 - d. Critical work sequencing and long lead items.
 - e. Designation of key personnel and their duties.
 - f. Lines of communications.
 - g. Use of web-based Project software.
 - h. Procedures for processing field decisions and Change Orders.
 - i. Procedures for RFIs.
 - j. Procedures for testing and inspecting.
 - k. Procedures for processing Applications for Payment.
 - l. Distribution of the Contract Documents.
 - m. Submittal procedures.
 - n. Preparation of Record Documents.
 - o. Use of the premises and existing building.
 - p. Work restrictions.
 - q. Working hours.
 - r. Owner's occupancy requirements.
 - s. Responsibility for temporary facilities and controls.
 - t. Procedures for moisture and mold control.
 - u. Procedures for disruptions and shutdowns.
 - v. Construction waste management and recycling.
 - w. Parking availability.
 - x. Office, work, and storage areas.
 - y. Equipment deliveries and priorities.
 - z. First aid.
 - aa. Security.
 - bb. Progress cleaning.
 3. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.
- C. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Engineer, but no later than 90 days prior to the scheduled date of Substantial Completion.

1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of Record Documents.
 - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
 - c. Procedures for completing and archiving web-based Project software site data files.
 - d. Submittal of written warranties.
 - e. Requirements for preparing operations and maintenance data.
 - f. Requirements for delivery of material samples, attic stock, and spare parts.
 - g. Requirements for demonstration and training.
 - h. Preparation of Contractor's punch list.
 - i. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
 - j. Submittal procedures.
 - k. Coordination of separate contracts.
 - l. Owner's partial occupancy requirements.
 - m. Installation of Owner's furniture, fixtures, and equipment.
 - n. Responsibility for removing temporary facilities and controls.
 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- D. Progress Meetings: Conduct progress meetings at regular intervals.
1. Coordinate dates of meetings with preparation of payment requests.
 2. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
 - a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's construction schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
 - 1) Review schedule for next period.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Resolution of BIM component conflicts.
 - 4) Status of submittals.

- 5) Deliveries.
 - 6) Off-site fabrication.
 - 7) Access.
 - 8) Site use.
 - 9) Temporary facilities and controls.
 - 10) Progress cleaning.
 - 11) Quality and work standards.
 - 12) Status of correction of deficient items.
 - 13) Field observations.
 - 14) Status of RFIs.
 - 15) Status of Proposal Requests.
 - 16) Pending changes.
 - 17) Status of Change Orders.
 - 18) Pending claims and disputes.
 - 19) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
 - a. Schedule Updating: Revise Contractor's construction schedule after each progress meeting, where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013100

SECTION 013300
SUBMITTAL PROCEDURES

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. Submittal schedule requirements.
- 2. Administrative and procedural requirements for submittals.

B. Related Requirements:

- 1. Section 012900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
- 2. Section 013100 "Project Management and Coordination" for submitting coordination drawings and subcontract list and for requirements for web-based Project software.
- 3. Section 013200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
- 4. Section 013233 "Photographic Documentation" for submitting preconstruction photographs, periodic construction photographs, and Final Completion construction photographs.
- 5. Section 014000 "Quality Requirements" for submitting test and inspection reports, and schedule of tests and inspections.
- 6. Section 017700 "Closeout Procedures" for submitting closeout submittals and maintenance material submittals.
- 7. Section 017823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
- 8. Section 017839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
- 9. Section 017900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."

1.4 SUBMITTAL SCHEDULE

- A. Submittal Schedule: Submit, as an action submittal, a list of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Engineer and additional time for handling and reviewing submittals required by those corrections.

1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
2. Initial Submittal Schedule: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
3. Final Submittal Schedule: Submit concurrently with the first complete submittal of Contractor's construction schedule.
 - a. Submit revised submittal schedule as required to reflect changes in current status and timing for submittals.
4. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal Category: Action; informational.
 - d. Name of subcontractor.
 - e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled date of fabrication.
 - i. Scheduled dates for installation.
 - j. Activity or event number.

1.5 SUBMITTAL FORMATS

- A. Submittal Information: Include the following information in each submittal:
 1. Project name.
 2. Date.
 3. Name of Engineer.
 4. Name of Contractor.
 5. Name of firm or entity that prepared submittal.
 6. Names of subcontractor, manufacturer, and supplier.
 7. Unique submittal number, including revision identifier. Include Specification Section number with sequential alphanumeric identifier and alphanumeric suffix for resubmittals.
 8. Category and type of submittal.
 9. Submittal purpose and description.
 10. Number and title of Specification Section, with paragraph number and generic name for each of multiple items.
 11. Drawing number and detail references, as appropriate.
 12. Indication of full or partial submittal.
 13. Location(s) where product is to be installed, as appropriate.
 14. Other necessary identification.
 15. Remarks.
 16. Signature of transmitter.
- B. Options: Identify options requiring selection by Engineer.
- C. Deviations and Additional Information: On each submittal, clearly indicate deviations from requirements in the Contract Documents, including minor variations and limitations; include relevant additional information and revisions, other than those requested by Engineer on

previous submittals. Indicate by highlighting on each submittal or noting on attached separate sheet.

- D. Electronic Submittals: Prepare submittals as PDF package, incorporating complete information into each PDF file. Name PDF file with submittal number.
- E. Submittals Utilizing Web-Based Project Software: Prepare submittals as PDF files or other format indicated by Project management software.

1.6 SUBMITTAL PROCEDURES

- A. Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Email: Prepare submittals as PDF package and transmit to Engineer by sending via email. Include PDF transmittal form. Include information in email subject line as requested by Engineer.
 - a. Engineer will return annotated file. Annotate and retain one copy of file as a digital Project Record Document file.
 - 2. Web-Based Project Management Software: Prepare submittals in PDF form, and upload to web-based Project management software website. Enter required data in web-based software site to fully identify submittal.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
 - 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of submittals for related parts of the Work specified in different Sections, so processing will not be delayed because of need to review submittals concurrently for coordination.
 - a. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
 - 1. Initial Review: Allow 10 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 - 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 - 3. Resubmittal Review: Allow 10 days for review of each resubmittal.
- D. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision in label or title block, and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Engineer's action stamp.

- E. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- F. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Engineer's action stamp.

1.7 SUBMITTAL REQUIREMENTS

- A. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. If information must be specially prepared for submittal because standard published data are unsuitable for use, submit as Shop Drawings, not as Product Data.
 - 2. Mark each copy of each submittal to show which products and options are applicable.
 - 3. Include the following information, as applicable:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.
 - 4. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams that show factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 - 5. Submit Product Data before Shop Drawings, and before or concurrently with Samples.
- B. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
 - 1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
- C. Product Schedule: As required in individual Specification Sections, prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
 - 1. Type of product. Include unique identifier for each product indicated in the Contract Documents or assigned by Contractor if none is indicated.
 - 2. Manufacturer and product name, and model number if applicable.
 - 3. Number and name of room or space.

4. Location within room or space.

D. Certificates:

1. Certificates and Certifications Submittals: Submit a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity. Provide a notarized signature where indicated.
2. Installer Certificates: Submit written statements on manufacturer's letterhead, certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.
3. Manufacturer Certificates: Submit written statements on manufacturer's letterhead, certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
4. Material Certificates: Submit written statements on manufacturer's letterhead, certifying that material complies with requirements in the Contract Documents.
5. Product Certificates: Submit written statements on manufacturer's letterhead, certifying that product complies with requirements in the Contract Documents.
6. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of AWS B2.1/B2.1M on AWS forms. Include names of firms and personnel certified.

E. Test and Research Reports:

1.8 DELEGATED-DESIGN SERVICES

- A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
 1. If criteria indicated are insufficient to perform services or certification required, submit a written request for additional information to Engineer.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF file copies of certificate, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

1.9 CONTRACTOR'S REVIEW

- A. Action Submittals and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.
- B. Contractor's Approval: Indicate Contractor's approval for each submittal with a uniform approval stamp. Include name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
 1. Engineer will not review submittals received from Contractor that do not have Contractor's review and approval.

1.10 ENGINEER'S REVIEW

- A. Action Submittals: Engineer will review each submittal, indicate corrections or revisions required, and return.
 1. PDF Submittals: Engineer will indicate, via markup on each submittal, the appropriate action.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

- B. Informational Submittals: Engineer will review each submittal and will not return it, or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Engineer.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Engineer will return without review submittals received from sources other than Contractor.
- F. Submittals not required by the Contract Documents will be returned by Engineer without action.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 013300

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

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 requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
 - 1. Retain subparagraphs below to cross-reference requirements Contractor might expect to find in this Section but are specified in other Sections.
 - 2. Section 011000 "Summary" for work restrictions and limitations on utility interruptions.
 - 3. Section 011200 "Multiple Contract Summary" for responsibilities for temporary facilities and controls for projects utilizing multiple contracts.
 - 4. Section 012100 "Allowances" for allowance for metered use of temporary utilities.

1.3 USE CHARGES

- A. Installation, removal, and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities engaged in the Project to use temporary services and facilities without cost, including, but not limited to, Engineer testing agencies, and authorities having jurisdiction.
- B. Electric Power Service: Owner will pay electric-power-service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Utilization Plan: Show temporary facilities, temporary utility lines and connections, staging areas, construction site entrances, vehicle circulation, and parking areas for construction personnel.
- B. Implementation and Termination Schedule: Within 5 days of date established for commencement of the Work, submit schedule indicating implementation and termination dates of each temporary utility.
- C. Project Identification and Temporary Signs: Show fabrication and installation details, including plans, elevations, details, layouts, typestyles, graphic elements, and message content.
- D. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- E. Moisture- and Mold-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage and mold. Describe delivery, handling, storage, installation, and protection provisions for materials subject to water absorption or water damage.
 - 1. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and requirements for replacing water-damaged Work.
 - 2. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

3. Indicate methods to be used to avoid trapping water in finished work.
 - F. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Include the following:
 1. Locations of dust-control partitions at each phase of work.
 2. HVAC system isolation schematic drawing.
 3. Location of proposed air-filtration system discharge.
 4. Waste-handling procedures.
 5. Other dust-control measures.
 - G. Noise and Vibration Control Plan: Identify construction activities that may impact the occupancy and use of existing spaces within the building or adjacent existing buildings, whether occupied by others, or occupied by the Owner. Include the following:
 1. Methods used to meet the goals and requirements of the Owner.
 2. Concrete cutting method(s) to be used.
 3. Location of construction devices on the site.
 4. Show compliance with the use and maintenance of quieted construction devices for the duration of the Project.
 5. Indicate activities that may disturb building occupants and that are planned to be performed during non-standard working hours as coordinated with the Owner.
 6. Indicate locations of sensitive [research] [patient] [equipment] <Insert item> areas or other areas requiring special attention as identified by Owner. Indicate means for complying with Owner's requirements.
- 1.5 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 United States Access Board's ADA-ABA Accessibility Guidelines] [and] [ICC/ANSI A117.1].
- 1.6 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, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Portable Chain-Link Fencing: Minimum 2-inch (50-mm), 0.148-inch- (3.8-mm-) thick, galvanized-steel, chain-link fabric fencing; minimum 6 feet (1.8 m) high with galvanized-steel pipe posts; minimum 2-3/8-inch- (60-mm-) OD line posts and 2-7/8-inch- (73-mm-) OD corner and pull posts, with 1-5/8-inch- (42-mm-) OD top and bottom rails. Provide galvanized-steel bases for supporting posts.
- B. Fencing Windscreen Privacy Screen: Polyester fabric scrim with grommets for attachment to chain-link fence, sized to height of fence, in color selected by Architect from manufacturer's standard colors.

- C. Polyethylene Sheet: Reinforced, fire-resistive sheet, 10-mil (0.25-mm) minimum thickness, with flame-spread rating of 15 or less in accordance with ASTM E84 and passing NFPA 701 Test Method 2.
- D. Dust-Control Adhesive-Surface Walk-Off Mats: Provide mats, minimum 36 by 60 inches (914 by 1524 mm).

2.2 TEMPORARY FACILITIES

- A. Field Offices: Owner will provide conditioned interior space for field offices for duration of Project.
- B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
 - 1. Store combustible materials apart from building.

2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; 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, Cooling, and Dehumidifying 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 017700 "Closeout Procedures."
- C. Retain "Air-Filtration Units" Paragraph below if negative-air-filtration units are required to maintain dust control for renovation work within occupied environments.
- D. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES, GENERAL

- A. Conservation: Coordinate construction and use of temporary facilities with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.
 - 1. Coordinate requirements in subparagraph below with provisions in Section 017419 "Construction Waste Management and Disposal."
 - 2. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work. See other Sections for disposition of salvaged materials that are designated as Owner's property.

3.2 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.
 - 1. Locate facilities to limit site disturbance as specified in Section 011000 "Summary."
- 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.

- C. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
 - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.
 - a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
 - b. Maintain negative air pressure within work area, using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
 - 2. Maintain dust partitions during the Work. Use vacuum collection attachments on dust-producing equipment. Isolate limited work within occupied areas using portable dust-containment devices.
 - 3. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.

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.
- B. Sanitary Facilities:
 - 1. Use of Permanent Toilets: Use of Owner's existing or new toilet facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- C. Temporary 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.
 - 1. Provide temporary dehumidification systems when required to reduce ambient and substrate moisture levels to level required to allow installation or application of finishes and their proper curing or drying.
- D. Electric Power Service: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- E. 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 underground unless otherwise indicated.
 - 2. Connect temporary service to Owner's existing power source, as directed by Owner.
- F. 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.

3.4 SUPPORT FACILITIES INSTALLATION

- A. Comply with the following:
 - 1. Provide construction for temporary field offices, shops, and sheds located within construction area or within 30 feet (9 m) of building lines that is noncombustible in accordance with ASTM E136. Comply with NFPA 241.
 - 2. Maintain support facilities until Engineer schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas

- C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
 - 1. Protect existing site improvements to remain, including curbs, pavement, and utilities.
 - 2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Parking: Use designated areas of Owner's existing parking areas for construction personnel. Contact number for University Police and Parking is (620) 235-4624
- E. Storage and Staging: Use designated areas of Project site for storage and staging needs.
- F. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. 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. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 017300 "Execution."
- H. 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.

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.
 - 1. Where access to adjacent properties is required in order to affect protection of existing facilities, obtain written permission from adjacent property owner to access property for that purpose.
- 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.
 - 1. Comply with work restrictions specified in Section 011000 "Summary."
- C. Temporary Erosion and Sedimentation Control: 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 requirements of EPA Construction General Permit or authorities having jurisdiction, whichever is more stringent.
 - 1. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree- or plant-protection zones.
 - 2. Inspect, repair, and maintain erosion- and sedimentation-control measures during construction until permanent vegetation has been established.
 - 3. Clean, repair, and restore adjoining properties and roads affected by erosion and sedimentation from Project site during the course of Project.
 - 4. Remove erosion and sedimentation controls, and restore and stabilize areas disturbed during removal.
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- 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 Egress: Provide temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction. Provide signage directing occupants to temporary
- H. 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 incomplete, insulate temporary enclosures.

3.6 MOISTURE AND MOLD CONTROL

- A. Moisture and Mold Protection: Protect stored materials and installed Work in accordance with Moisture and Mold Protection Plan.
- B. Exposed Construction Period: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
 - 1. Protect porous materials from water damage.
 - 2. Protect stored and installed material from flowing or standing water.
 - 3. Keep porous and organic materials from coming into prolonged contact with concrete.
 - 4. Remove standing water from decks.
 - 5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Period: 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. Periodically collect and remove waste containing cellulose or other organic matter.
 - 4. Discard or replace water-damaged material.
 - 5. Do not install material that is wet.
 - 6. Discard and replace stored or installed material that begins to grow mold.
 - 7. Perform work in a sequence that allows wet materials adequate time to dry before enclosing the material in gypsum board or other interior finishes.
- D. Controlled Construction Period: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
 - 1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
 - 2. Use temporary or permanent HVAC system to control humidity within ranges specified for installed and stored materials.
 - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
 - a. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 48 hours are considered defective and require replacing.
 - b. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record readings beginning at time of exposure and continuing daily for 48 hours. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
 - c. Remove and replace 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. Comply with final cleaning requirements specified in Section 017700 "Closeout Procedures."

END OF SECTION 015000

SECTION 016000

PRODUCT 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.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
 - 1. Section 011000 "Summary" for Contractor requirements related to Owner-furnished products.
 - 2. Section 012100 "Allowances" for products selected under an allowance.
 - 3. Section 012300 "Alternates" for products selected under an alternate.
 - 4. Section 012500 "Substitution Procedures" for requests for substitutions.
 - 5. Section 014200 "References" for applicable industry standards for products specified.
 - 6. Section 01770 "Closeout Procedures" for submitting warranties.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Salvaged items or items reused from other projects are not considered new products. Items that are manufactured or fabricated to include recycled content materials are considered new products, unless indicated otherwise.
 - 3. Comparable Product: Product by named manufacturer that is demonstrated and approved through the comparable product submittal process described in Part 2 "Comparable Products" Article, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - 1. Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. **Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.**

- C. Subject to Compliance with Requirements: Where the phrase "Subject to compliance with requirements" introduces a product selection procedure in an individual Specification Section, provide products qualified under the specified product procedure. In the event that a named product or product by a named manufacturer does not meet the other requirements of the specifications, select another named product or product from another named manufacturer that does meet the requirements of the specifications; submit a comparable product request or substitution request, if applicable.
- D. Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - 1. Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
 - 2. Data indicating compliance with the requirements specified in Part 2 "Comparable Products" Article.
- E. Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 013300 "Submittal Procedures."
- F. Substitution: Refer to Section 012500 "Substitution Procedures" for definition and limitations on substitutions.

1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.
 - 1. Resolution of Compatibility Disputes between Multiple Contractors:
 - a. Contractors are responsible for providing products and construction methods compatible with products and construction methods of other contractors.
 - b. If a dispute arises between the multiple contractors over concurrently selectable but incompatible products, Engineer will determine which products shall be used.
- B. Identification of Products: Except for required labels and operating data, do not attach or imprint manufacturer or product names or trademarks on exposed surfaces of products or equipment that will be exposed to view in occupied spaces or on the exterior.
 - 1. Labels: Locate required product labels and stamps on a concealed surface, or, where required for observation following installation, on a visually accessible surface that is not conspicuous.
 - 2. Equipment Nameplates: Provide a permanent nameplate on each item of service- or power-operated equipment. Locate on a visually accessible but inconspicuous surface. Include information essential for operation, including the following:
 - a. Name of product and manufacturer.
 - b. Model and serial number.
 - c. Capacity.
 - d. Speed.
 - e. Ratings.
 - 3. See individual identification Sections in Divisions 21, 22, 23, and 26 for additional equipment identification requirements.

1.5 COORDINATION

- A. Modify or adjust affected work as necessary to integrate work of approved comparable products and approved substitutions.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products, using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 - 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 - 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 - 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 - 4. Inspect products on delivery to determine compliance with the Contract Documents and that products are undamaged and properly protected.
- C. Storage:
 - 1. Provide a secure location and enclosure at Project site for storage of materials and equipment.
 - 2. Store products to allow for inspection and measurement of quantity or counting of units.
 - 3. Store materials in a manner that will not endanger Project structure.
 - 4. Store products that are subject to damage by the elements under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation and with adequate protection from wind.
 - 5. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
 - 6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
 - 7. Protect stored products from damage and liquids from freezing.
 - 8. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
 - 1. Manufacturer's Warranty: Written standard warranty form furnished by individual manufacturer for a particular product and issued in the name of the Owner or endorsed by manufacturer to Owner.
 - 2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner and issued in the name of the Owner or endorsed by manufacturer to Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
 - 1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 - 2. Specified Form: When specified forms are included in the Project Manual, prepare a written document, using indicated form properly executed.

3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Section 017700 "Closeout Procedures."

PART 2 - PRODUCTS

A. PRODUCT SELECTION PROCEDURES

1. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
 - a. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 - b. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 - c. Owner reserves the right to limit selection to products with warranties meeting requirements of the Contract Documents.
 - d. Where products are accompanied by the term "as selected," Engineer will make selection.
 - e. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 - f. Or Equal: For products specified by name and accompanied by the term "or equal," "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.
 - 1) Submit additional documentation required by Engineer in order to establish equivalency of proposed products. Unless otherwise indicated, evaluation of "or equal" product status is by the Engineer, whose determination is final.
2. Product Selection Procedures:
 - a. Sole Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 1) Sole product may be indicated by the phrase "Subject to compliance with requirements, provide the following."
 - b. Sole Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
 - 1) Sole manufacturer/source may be indicated by the phrase "Subject to compliance with requirements, provide products by the following."
 - c. Limited List of Products: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not be considered unless otherwise indicated**.
 - 1) Limited list of products may be indicated by the phrase "Subject to compliance with requirements, provide one of the following."
 - d. Non-Limited List of Products: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed or an unnamed product that complies with requirements.

- 1) Non-limited list of products is indicated by the phrase "Subject to compliance with requirements, available products that may be incorporated in the Work include, but are not limited to, the following."
 - 2) Provision of an unnamed product is not considered a substitution, if the product complies with requirements.
- e. Limited List of Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience **will not** be considered **unless otherwise indicated**.
- 1) Limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, provide products by one of the following."
- f. Non-Limited List of Manufacturers: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed or a product by an unnamed manufacturer that complies with requirements.
- 1) Non-limited list of manufacturers is indicated by the phrase "Subject to compliance with requirements, available manufacturers whose products may be incorporated in the Work include, but are not limited to, the following."
 - 2) Provision of products of an unnamed manufacturer is not considered a substitution, if the product complies with requirements.
- g. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications may additionally indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.
- h. For approval of products by unnamed manufacturers, comply with requirements in Section 012500 "Substitution Procedures" for substitutions for convenience.

2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration of Comparable Products: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with the following requirements:
1. Evidence that proposed product does not require revisions to the Contract Documents, is consistent with the Contract Documents, will produce the indicated results, and is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those of the named basis-of-design product. Significant product qualities include attributes, such as type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other specific features and requirements.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects, with project names and addresses and names and addresses of Engineer and owners, if requested.
 5. Samples, if requested.
- B. Engineers Action on Comparable Products Submittal: If necessary, Engineer will request additional information or documentation for evaluation, as specified in Section 013300 "Submittal Procedures."
1. Form of Approval of Submittal: As specified in Section 013300 "Submittal Procedures."

2. Use product specified if Engineer does not issue a decision on use of a comparable product request within time allocated.
- C. Submittal Requirements, Two-Step Process: Approval by the Engineer of Contractor's request for use of comparable product is not intended to satisfy other submittal requirements. Comply with specified submittal requirements.
- D. Submittal Requirements, Single-Step Process: When acceptable to Engineer, incorporate specified submittal requirements of individual Specification Section in combined submittal for comparable products. Approval by the Engineer of Contractor's request for use of comparable product and of individual submittal requirements will also satisfy other submittal requirements.

PART 3 - EXECUTION (NOT USED)

END OF SECTION 016000

SECTION 017300

EXECUTION

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 general administrative and procedural requirements governing execution of the Work, including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Coordination of Owner's portion of the Work.
 - 6. Coordination of Owner-installed products.
 - 7. Progress cleaning.
 - 8. Starting and adjusting.
 - 9. Protection of installed construction.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of subsequent work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of subsequent work.

1.4 QUALITY ASSURANCE

- A. Professional Engineer Qualifications: Refer to Section 014000 "Quality Requirements."
- B. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
 - 1. Structural Elements: When cutting and patching structural elements, or when encountering the need for cutting and patching of elements whose structural function is not known, notify Engineer of locations and details of cutting and await directions from Engineer before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection.
 - 2. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety. Operational elements include the following:
 - a. Primary operational systems and equipment.
 - b. Fire separation assemblies.
 - c. Air or smoke barriers.
 - d. Fire-suppression systems.
 - e. Plumbing piping systems.
 - f. Mechanical systems piping and ducts.

- g. Control systems.
 - h. Communication systems.
 - i. Fire-detection and -alarm systems.
 - j. Conveying systems.
 - k. Electrical wiring systems.
 - l. Operating systems of special construction.
3. Other Construction Elements: Do not cut and patch other construction elements or components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety. Other construction elements include but are not limited to the following:
- a. Water, moisture, or vapor barriers.
 - b. Membranes and flashings.
 - c. Exterior curtain-wall construction.
 - d. Sprayed fire-resistive material.
 - e. Equipment supports.
 - f. Piping, ductwork, vessels, and equipment.
 - g. Noise- and vibration-control elements and systems.
4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of specified products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with requirements specified in other Sections.
- 1. For projects requiring compliance with sustainable design and construction practices and procedures, use products for patching that comply with sustainable design requirements.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Engineer for the visual and functional performance of in-place materials. Use materials that are not considered hazardous.
- C. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate

and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, gas service piping, and water-service piping; underground electrical services; and other utilities.
 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
1. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:
1. Description of the Work, including Specification Section number and paragraph, and Drawing sheet number and detail, where applicable.
 2. List of detrimental conditions, including substrates.
 3. List of unacceptable installation tolerances.
 4. Recommended corrections.
- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Engineer in accordance with requirements in Section 013100 "Project Management and Coordination."

3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks and existing conditions. If discrepancies are discovered, notify Engineer promptly.

3.4 INSTALLATION

- A. Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb, and make horizontal work level.
 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 3. Conceal pipes, ducts, and wiring in finished areas unless otherwise indicated.
 4. Maintain maximum headroom where possible. Minimum headroom clearance of 96 inches (2440 mm)] in occupied spaces and 90 inches (2300 mm) in unoccupied spaces, unless otherwise indicated on Drawings.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure satisfactory results as judged by Engineer. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations, so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy of type expected for Project.
- E. Sequence the Work and allow adequate clearances to accommodate movement of construction items on-site and placement in permanent locations.
- F. Tools and Equipment: Select tools or equipment that minimize production of excessive noise levels.
- G. Templates: Obtain and distribute to the parties involved templates for Work specified to be factory prepared and field installed. Check Shop Drawings of other portions of the Work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions with manufacturer.
1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 2. Allow for building movement, including thermal expansion and contraction.
 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- I. Joints: Make joints of uniform width. Where joint locations in exposed Work are not indicated, arrange joints for the best visual effect, as judged by Engineer. Fit exposed connections together to form hairline joints.
- J. Repair or remove and replace damaged, defective, or nonconforming Work.
1. Comply with Section 017700 "Closeout Procedures" for repairing or removing and replacing defective Work.
- 3.5 CUTTING AND PATCHING**
- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of Work to be cut.

- D. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- E. Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching in accordance with requirements in Section 011000 "Summary."
- F. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to minimize interruption to occupied areas.
- G. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - 1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
 - 2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
 - 3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - 4. Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - 5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
 - 6. Proceed with patching after construction operations requiring cutting are complete.
- H. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as practicable, as judged by Engineer. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical integrity of installation.
 - 2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
 - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - b. Restore damaged pipe covering to its original condition.
 - 3. Insert specific refinishing requirements for floors, walls, and ceilings. Revise "Floors and Walls" Subparagraph below to suit Project.
 - 4. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
 - a. Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch, corner to corner of wall and edge to edge of ceiling. Provide additional coats until patch blends with adjacent surfaces.

5. Revise "Ceilings" Subparagraph below to suit Project or delete.
 6. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.
 7. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition and ensures thermal and moisture integrity of building enclosure.
- I. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.
- 3.6 COORDINATION OF OWNER'S PORTION OF THE WORK
- A. Site Access: Provide access to Project site for Owner's construction personnel and Owner's separate contractors.
 - B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction personnel and Owner's separate contractors.
 1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
 2. Preinstallation Conferences: Include Owner's construction personnel and Owner's separate contractors at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction personnel if portions of the Work depend on Owner's construction.
- 3.7 PROGRESS CLEANING
- A. Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F (27 deg C).
 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Use containers intended for holding waste materials of type to be stored.
 4. Retain subparagraph below for projects involving multiple contracts.
 5. Coordinate progress cleaning for joint-use areas where Contractor and other contractors are working concurrently.
 - B. Site: Maintain Project site free of waste materials and debris.
 - C. Work Areas: Clean areas where Work is in progress to the level of cleanliness necessary for proper execution of the Work.
 1. Remove liquid spills promptly.
 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
 - D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
 - E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
 - F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 015000 "Temporary Facilities and Controls." And Section 017419 "Construction Waste Management and Disposal."
- H. Three paragraphs below reduce or eliminate the need for similar provisions in other Sections. Insert other provisions needed because of unusual Project conditions. Specify unusual provisions for specific work in the individual Section.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. If necessary, revise "Limiting Exposures" Paragraph below by inserting a list of exposures. See the Evaluations.
- L. Limiting Exposures: Supervise construction operations to ensure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.8 STARTING AND ADJUSTING

- A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- B. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Manufacturer's Field Service: Comply with qualification requirements in Section 014000 "Quality Requirements."

3.9 PROTECTION AND REPAIR OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Repair Work previously completed and subsequently damaged during construction period. Repair to like-new condition.
- C. Protection of Existing Items: Provide protection and ensure that existing items to remain undisturbed by construction are maintained in condition that existed at commencement of the Work.
- D. Comply with manufacturer's written instructions for temperature and relative humidity.

END OF SECTION 017300

SECTION 017700
CLOSEOUT PROCEDURES

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 administrative and procedural requirements for Contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Requirements:
 - 1. Section 017823 "Operation and Maintenance Data" for additional operation and maintenance manual requirements.
 - 2. Section 017839 "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Section 017900 "Demonstration and Training" for requirements to train the Owner's maintenance personnel to adjust, operate, and maintain products, equipment, and systems.

1.3 DEFINITIONS

- A. List of Incomplete Items: Contractor-prepared list of items to be completed or corrected, prepared for the Engineer's use prior to Engineer's inspection, to determine if the Work is substantially complete.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cleaning agent.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

1.5 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.
- C. Field Report: For pest-control inspection.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items required by other Sections.

1.7 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's "punch list"), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.

1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction, permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 2. Submit closeout submittals specified in other Division 01 Sections, including Project Record Documents, operation and maintenance manuals, damage or settlement surveys, property surveys, and similar final record information.
 3. Submit closeout submittals specified in individual Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
 4. Submit maintenance material submittals specified in individual Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Engineer. Label with manufacturer's name and model number.
 - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Engineer's and Owner's signature for receipt of submittals.
 5. Submit testing, adjusting, and balancing records.
 6. Submit sustainable design submittals not previously submitted.
 7. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
1. Advise Owner of pending insurance changeover requirements.
 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 3. Complete startup and testing of systems and equipment.
 4. Perform preventive maintenance on equipment used prior to Substantial Completion.
 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Section 017900 "Demonstration and Training."
 6. Advise Owner of changeover in utility services.
 7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
 8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
 9. Complete final cleaning requirements.
 10. Touch up paint and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of [0 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for Final Completion.

1.8 FINAL COMPLETION PROCEDURES

- A. Submittals Prior to Final Completion: Before requesting final inspection for determining Final Completion, complete the following:
 - 1. Submit a final Application for Payment in accordance with Section 012900 "Payment Procedures."
 - 2. Certified List of Incomplete Items: Submit certified copy of Engineer's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Engineer. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
 - 3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 4. Submit pest-control final inspection report.
 - 5. Submit Final Completion photographic documentation.
- B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the Work will be completed and ready for final inspection and tests. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.9 LIST OF INCOMPLETE ITEMS

- A. Organization of List: Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction.
 - 1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor, listed by room or space number.
 - 2. Organize items applying to each space by major element, including categories for ceilings, individual walls, floors, equipment, and building systems.
 - 3. Include the following information at the top of each page:
 - a. Project name.
 - b. Date.
 - c. Name of Engineer
 - d. Name of Contractor.
 - e. Page number.
 - 4. Submit list of incomplete items in the following format:
 - a. MS Excel Electronic File: Engineer will return annotated file.
 - b. PDF Electronic File: Engineer will return annotated file.

1.10 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Engineer for designated portions of the Work where warranties are indicated to commence on dates other than date of Substantial Completion, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.

- D. Warranty Electronic File: Provide warranties and bonds in PDF format. Assemble complete warranty and bond submittal package into a single electronic PDF file with bookmarks enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
 - 1. Submit on digital media acceptable to Engineer
- E. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.
 - a. Use cleaning products that comply with Green Seal's GS-37, or if GS-37 is not applicable, use products that comply with the California Code of Regulations maximum allowable VOC levels.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.
 - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a designated portion of Project:
 - a. Clean Project site of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are not planted, mulched, or paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. Remove snow and ice to provide safe access to building.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
 - g. Remove debris and surface dust from limited-access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
 - h. Clean flooring, removing debris, dirt, and staining; clean according to manufacturer's recommendations.
 - i. Vacuum and mop concrete.
 - j. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations if visible soil or stains remain.
 - k. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Polish mirrors and glass, taking care not to scratch surfaces.
 - l. Remove labels that are not permanent.

- m. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
 - n. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
 - o. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
 - p. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
 - 1) Clean HVAC system in compliance with NADCA ACR. Provide written report on completion of cleaning.
 - q. Clean luminaires, lamps, globes, and reflectors to function with full efficiency.
Leave Project clean and ready for occupancy.
2. Construction Waste Disposal: Comply with waste-disposal requirements in Section 015000 "Temporary Facilities and Controls." and Section 017419 "Construction Waste Management and Disposal."

3.2 REPAIR OF THE WORK

- 1. Complete repair and restoration operations required by Section 017300 "Execution" before requesting inspection for determination of Substantial Completion.

END OF SECTION 017700

SECTION 017823

OPERATION AND MAINTENANCE DATA

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 administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory manuals.
 - 2. Emergency manuals.
 - 3. Systems and equipment operation manuals.
 - 4. Systems and equipment maintenance manuals.
 - 5. Product maintenance manuals.
- B. Related Requirements:
 - 1. Section 011200 "Multiple Contract Summary" for coordinating operation and maintenance manuals covering the Work of multiple contracts.
 - 2. Section 013300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 CLOSEOUT SUBMITTALS

- A. Submit operation and maintenance manuals indicated. Provide content for each manual as specified in individual Specification Sections, and as reviewed and approved at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
 - 1. Engineer will comment on whether content of operation and maintenance submittals is acceptable.
 - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.
- B. Format: Submit operation and maintenance manuals in the following format:
 - 1. Submit **on digital media acceptable to Engineer**. Enable reviewer comments on draft submittals.
- C. Initial Manual Submittal: Submit draft copy of each manual at least **30** days before commencing demonstration and training. Engineer will comment on whether general scope and content of manual are acceptable.

- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least **15** days before commencing demonstration and training. Engineer will return copy with comments.
 - 1. Correct or revise each manual to comply with Engineer's comments. Submit copies of each corrected manual within **15** days of receipt of Engineer's comments and prior to commencing demonstration and training.
- E. Comply with Section 017700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

1.5 FORMAT OF OPERATION AND MAINTENANCE MANUALS

- A. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
 - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 - 2. File Names and Bookmarks: Bookmark individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

1.6 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- A. Organization of Manuals: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
 - 1. Title page.
 - 2. Table of contents.
 - 3. Manual contents.
- B. Title Page: Include the following information:
 - 1. Subject matter included in manual.
 - 2. Name and address of Project.
 - 3. Name and address of Owner.
 - 4. Date of submittal.
 - 5. Name and contact information for Contractor.
 - 6. Name and contact information for Construction Manager.
 - 7. Name and contact information for Engineer.
 - 8. Name and contact information for Commissioning Authority.
 - 9. Names and contact information for major consultants to the Engineer that designed the systems contained in the manuals.
 - 10. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems."

1.7 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY MANUAL

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals. List items and their location to facilitate ready access to desired information. Include the following:
 1. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
 2. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
 3. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.

1.8 SYSTEMS AND EQUIPMENT OPERATION MANUALS

- A. Systems and Equipment Operation Manual: Assemble a complete set of data indicating operation of each system, subsystem, and piece of equipment not part of a system. Include information required for daily operation and management, operating standards, and routine and special operating procedures.
 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Performance and design criteria if Contractor has delegated design responsibility.
 3. Operating standards.
 4. Operating procedures.
 5. Operating logs.
 6. Wiring diagrams.
 7. Control diagrams.
 8. Piped system diagrams.
 9. Precautions against improper use.
 10. License requirements including inspection and renewal dates.

- C. Descriptions: Include the following:
 - 1. Product name and model number. Use designations for products indicated on Contract Documents.
 - 2. Manufacturer's name.
 - 3. Equipment identification with serial number of each component.
 - 4. Equipment function.
 - 5. Operating characteristics.
 - 6. Limiting conditions.
 - 7. Performance curves.
 - 8. Engineering data and tests.
 - 9. Complete nomenclature and number of replacement parts.
- D. Operating Procedures: Include the following, as applicable:
 - 1. Startup procedures.
 - 2. Equipment or system break-in procedures.
 - 3. Routine and normal operating instructions.
 - 4. Regulation and control procedures.
 - 5. Instructions on stopping.
 - 6. Normal shutdown instructions.
 - 7. Seasonal and weekend operating instructions.
 - 8. Required sequences for electric or electronic systems.
 - 9. Special operating instructions and procedures.
- E. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- F. Piped Systems: Diagram piping as installed, and identify color coding where required for identification.

1.9 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- A. Systems and Equipment Maintenance Manuals: Assemble a complete set of data indicating maintenance of each system, subsystem, and piece of equipment not part of a system. Include manufacturers' maintenance documentation, preventive maintenance procedures and frequency, repair procedures, wiring and systems diagrams, lists of spare parts, and warranty information.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- B. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranties and bonds as described below.

- C. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Manufacturers' Maintenance Documentation: Include the following information for each component part or piece of equipment:
 - 1. Standard maintenance instructions and bulletins; include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
 - a. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
 - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 - 3. Identification and nomenclature of parts and components.
 - 4. List of items recommended to be stocked as spare parts.
- E. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
 - 1. Test and inspection instructions.
 - 2. Troubleshooting guide.
 - 3. Precautions against improper maintenance.
 - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - 5. Aligning, adjusting, and checking instructions.
 - 6. Demonstration and training video recording, if available.
- F. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- G. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- H. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- I. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

J. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of maintenance manuals.

1.10 PRODUCT MAINTENANCE MANUALS

- A. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- B. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- C. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- D. Product Information: Include the following, as applicable:
 1. Product name and model number.
 2. Manufacturer's name.
 3. Color, pattern, and texture.
 4. Material and chemical composition.
 5. Reordering information for specially manufactured products.
- E. Maintenance Procedures: Include manufacturer's written recommendations and the following:
 1. Inspection procedures.
 2. Types of cleaning agents to be used and methods of cleaning.
 3. List of cleaning agents and methods of cleaning detrimental to product.
 4. Schedule for routine cleaning and maintenance.
 5. Repair instructions.
- F. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- G. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 1. Include procedures to follow and required notifications for warranty claims.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017823

SECTION 017839

PROJECT RECORD DOCUMENTS

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 administrative and procedural requirements for Project Record Documents, including the following:
 - 1. Record Drawings.
 - 2. Record specifications.
 - 3. Record Product Data.
 - 4. Miscellaneous record submittals.

1.3 RELATED REQUIREMENTS:

- A. Section 011200 "Multiple Contract Summary" for coordinating Project Record Documents covering the Work of multiple contracts.
- B. Section 017700 "Closeout Procedures" for general closeout procedures.
- C. Section 017823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

1.4 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set(s) of marked-up record prints.
 - 2. Number of Copies: Submit copies of Record Drawings as follows:
 - a. Initial Submittal:
 - 1) Submit PDF electronic files of scanned record prints and one set(s) of file prints.
 - 2) Submit Record Digital Data Files and one set(s) of plots.
 - 3) Engineer will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
 - b. Final Submittal:
 - 1) Submit PDF electronic files of scanned Record Prints and three set(s) of file prints.
 - c. Final Submittal:
 - 1) Submit Record Digital Data Files and three set(s) of Record Digital Data File plots.
 - 2) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and Contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
 - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.

- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into Project Record Documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

1.5 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation, where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction or Work Change Directive.
 - k. Changes made following Engineer's written orders.
 - l. Details not on the original Contract Drawings.
 - m. Field records for variable and concealed conditions.
 - n. Record information on the Work that is shown only schematically.
 - 3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
 - 4. Mark record prints with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
 - 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
 - 6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Format: Identify and date each Record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
 - 1. Record Prints: Organize record prints into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.

2. Format: Annotated PDF electronic file with comment function enabled.
3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
4. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Engineer.
 - e. Name of Contractor.

1.6 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation, where installation varies from that indicated in Specifications, addenda, and Contract modifications.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether Record Product Data has been submitted in operation and maintenance manuals instead of submitted as Record Product Data.
 5. Note related Change Orders, Record Product Data, and Record Drawings where applicable.
- B. Format: Submit record specifications as annotated PDF electronic file.

1.7 RECORD PRODUCT DATA

- A. Recording: Maintain one copy of each submittal during the construction period for Project Record Document purposes. Post changes and revisions to Project Record Documents as they occur; do not wait until end of Project.
- B. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 3. Note related Change Orders, Record Specifications, and Record Drawings where applicable.
- C. Format: Submit Record Product Data as annotated PDF electronic file.
 1. Include Record Product Data directory organized by Specification Section number and title, electronically linked to each item of Record Product Data.

1.8 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file
 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

1.9 MAINTENANCE OF RECORD DOCUMENTS

- A. Maintenance of Record Documents: Store Record Documents in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain Record Documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to Project Record Documents for Engineer's reference during normal working hours.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 017839

SECTION 017900

DEMONSTRATION AND TRAINING

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 administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Instruction in operation and maintenance of systems, subsystems, and equipment.

1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For **facilitator**.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 CLOSEOUT SUBMITTALS

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data have been reviewed and approved by Engineer.

1.6 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 017823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

1.7 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Owner will furnish Contractor with names and positions of participants.
- D. Scheduling: Provide instruction at mutually agreed-on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
 - 1. Schedule training with Owner with at least **seven** days' advance notice.
- E. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- F. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a performance-based test.
- G. Cleanup: Collect used and leftover educational materials and **give to Owner**. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

PART 2 - PRODUCTS

PART 3 - EXECUTION

END OF SECTION 017900

SECTION 011000

SUMMARY

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. Project information.
2. Work covered by Contract Documents.
3. Multiple Work Packages.
4. Contractor's use of site and premises.
5. Coordination with occupants.
6. Work restrictions.
7. Specification and Drawing conventions.
8. Miscellaneous provisions.

B. Related Requirements:

1. Section 015000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.3 DEFINITIONS

- A. Work Package: A group of specifications, drawings, and schedules prepared by the design team to describe a portion of the Project Work for pricing, permitting, and construction.

1.4 PROJECT INFORMATION

A. Project Identification: A-014285 PSU Weede Fieldhouse HVAC Upgrades

1. Project Location: Weede Field House

B. Owner: Pittsburg State University

1. Owner's Representative:
 - a. Lindell Haverstic, University Architect & Director Planning, Design & Construction.
 - b. 1701 South Broadway
 - c. Pittsburg, KS 66762
 - d. Telephone: 620-235-4130

C. Engineer: Henderson Engineers.

1. Engineers Representative:
 - a. Danny McGrail
 - b. 8435 Lenexa Dr. Suite 300
 - c. Lenexa, KS 66214
 - d. Telephone: 913-742-5419

1.5 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of Project is defined by the Contract Documents and includes, but is not limited to, the following:
 1. Scope of demolition as shown on the drawings and as described in the specifications.

2. Electrical upgrades to support the installation of the new Daktronics scoreboards, videoboards, and other athletic components (scoring tables, locker room clocks, etc.) and installation of an HVAC system for the fieldhouse and necessary structural, plumbing and electrical components to support the new HVAC system and other Work indicated in the Contract Documents.

B. Type of Contract:

1. Project will be constructed under a single prime contract with exception of the electrical upgrades to support the installation of the new Daktronics scope which will be constructed by one of Pittsburg State University's on-call electrical contractors. This scope will be procured outside the scope of this contract.

1.6 WORK UNDER OWNER'S SEPARATE CONTRACTS

- A. Work with Separate Contractors: Cooperate fully with Owner's separate contractors, so work on those contracts may be carried out smoothly, without interfering with or delaying Work under this Contract or other contracts. Coordinate the Work of this Contract with work performed under Owner's separate contracts.
- B. Concurrent Work: Owner will award separate contract(s) for the following construction operations at Project site. Those operations will be conducted simultaneously with Work under this Contract.
 1. Daktronics electrical infrastructure.

1.7 CONTRACTOR'S USE OF SITE AND PREMISES

- A. Restricted Use of Site: Contractor shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.
- B. Limits on Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
 1. Limits on Use of Site: Confine construction operations to areas shown within construction documents.
 2. Driveways, Walkways and Entrances: Keep driveways and loading areas, and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or for storage of materials.
 - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
 - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.
- D. Condition of Existing Grounds: Maintain portions of existing grounds, landscaping, and hardscaping affected by construction operations throughout construction period. Repair damage caused by construction operations.

1.8 COORDINATION WITH OCCUPANTS

- A. Full Owner Occupancy: Owner will occupy Project site and the existing building(s) during entire construction period. Cooperate with Owner during construction operations to minimize conflicts and facilitate Owner usage. Perform the Work so as not to interfere with Owner's day-to-day operations. Maintain existing exits unless otherwise indicated. Coordinate required schedule with owner.
 1. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities. Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from Owner and approval of authorities having jurisdiction.

2. Notify Owner not less than 72 hours in advance of activities that will affect Owner's operations.
- B. Owner Limited Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed portions of the Work, prior to Substantial Completion of the Work, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and limited occupancy shall not constitute acceptance of the total Work.
1. Engineer will prepare a Certificate of Substantial Completion for each specific portion of the Work to be occupied prior to Owner acceptance of the completed Work.
 2. Obtain a Certificate of Occupancy from authorities having jurisdiction before limited Owner occupancy.
 3. Before limited Owner occupancy, mechanical and electrical systems shall be fully operational, and required tests and inspections shall be successfully completed. On occupancy, Owner will operate and maintain mechanical and electrical systems serving occupied portions of Work.
 4. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of Work.

1.9 WORK RESTRICTIONS

- A. Comply with restrictions on construction operations.
1. Comply with limitations on use of public streets, work on public streets, rights of way, and other requirements of authorities having jurisdiction.
- B. On-Site Work Hours: Contractor operating hours and access to the site and existing building are 24/7, both weekdays and weekends. However, other than operations required to occur during normal working hours, all construction activities shall occur during normal business hours.
- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging for temporary utility services according to requirements indicated:
1. Notify Owner not less than 5 days in advance of proposed utility interruptions.
 2. Obtain Owner's written permission before proceeding with utility interruptions.
- D. Noise, Vibration, Dust, and Odors: Coordinate operations that may result in high levels of noise and vibration, dust, odors, or other disruption to Owner occupancy with Owner.
1. Notify Owner not less than 5 days in advance of proposed disruptive operations.
 2. Obtain Owner's written permission before proceeding with disruptive operations.
- E. Smoking and Controlled Substance Restrictions: Use of tobacco products, alcoholic beverages, and other controlled substances on Owner's property is not permitted.
- F. Employee Identification: Provide identification tags for Contractor personnel working on Project site. Require personnel to use identification tags at all times.

1.10 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. Text Color: Text used in the Specifications, including units of measure, manufacturer and product names, and other text may appear in multiple colors or underlined as part of a hyperlink; no emphasis is implied by text with these characteristics.

3. Hypertext: Text used in the Specifications may contain hyperlinks. Hyperlinks may allow for access to linked information that is not residing in the Specifications. Unless otherwise indicated, linked information is not part of the Contract Documents.
 4. Specification requirements are to be performed by Contractor unless specifically stated otherwise.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to the Work of all Sections in the Specifications.
- C. 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 scheduled on Drawings and published as part of the U.S. National CAD Standard.
 3. Keynoting: Materials and products are identified by reference keynotes referencing Specification Section numbers found in this Project Manual.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011000

SECTION 011200

MULTIPLE CONTRACT SUMMARY

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 a summary of each contract, including responsibilities for coordination and temporary facilities and controls.
- B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.
- C. Related Requirements:
 - 1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, coordination with occupants, and work restrictions.
 - 2. Section 013100 "Project Management and Coordination" for general coordination requirements.

1.3 DEFINITIONS

- A. Permanent Enclosure: As determined by Engineer, the condition at which roofing is insulated and weathertight; exterior walls are insulated and weathertight; and openings are closed with permanent construction or substantial temporary closures equivalent in weather protection to permanent construction.

1.4 GENERAL REQUIREMENTS OF CONTRACTS

- A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of Project.
 - 1. Unless otherwise indicated, the work described in this Section for each contract shall be complete systems and assemblies, including products, components, accessories, and installation required by the Contract Documents.
 - 2. Trenches and other excavation for the work of each contract shall be the work of the General Construction Contract
 - 3. Blocking, backing panels, sleeves, and metal fabrication supports for the work of each contract shall be the work of each contract for its own work.
 - 4. Furnishing of access panels for the work of each contract shall be the work of each contract for its own work. Installation of access panels shall be the work of each contract for its own work.
 - 5. Equipment pads for the work of each contract shall be the work of each contract for its own work.
 - 6. Painting for the work of each contract shall be the work of each contract for its own work.
 - 7. Cutting and Patching: Provided under each contract for its own work.

8. Through-penetration firestopping for the work of each contract shall be provided by each contract for its own work.
- B. Temporary Heating, Cooling, and Ventilation: The General Construction Contract is responsible for temporary heating, cooling, and ventilation, including utility-use charges, temporary meters, and temporary connections.
- C. Use Charges: Comply with the following:
- D. Work of the General Construction Contract includes, but is not limited to, the following:
1. Remaining work not identified as work under other contracts.
 2. Site preparation, including clearing, building demolition and relocations, and earthwork.
 3. Site improvements, including roadways, parking lots, pedestrian paving, site development furnishings and equipment, and landscaping.
 4. Tunnels for site utilities.
 5. Selective demolition.
 6. Slabs-on-grade, including earthwork, subdrainage systems, and insulation.
 7. Below-grade building construction, including excavation, backfill, and insulation and waterproofing/dampproofing.
 8. Exterior closure, including walls, doors, windows, and louvers.
 9. Roofing, including roof insulation, coverings, flashing, roof specialties, roof accessories, and glazed openings.
 10. Interior construction, including partitions, doors, and fittings.
 11. Fire-protection specialties.
 12. Stairs, including railings and finishes.
 13. Interior finishes finish carpentry, architectural woodwork ,interior specialties, and floor and ceiling finishes.
 14. Miscellaneous items, including concrete equipment bases and painting of mechanical and electrical work.
- E. Temporary facilities and controls in the General Construction Contract include, but are not limited to, the following:
1. Temporary facilities and controls that are not otherwise specifically assigned to the Electrical Contract.
 2. Sediment and erosion control.
 3. Unpiped sewers and drainage, including drainage ditches, dry wells, stabilization ponds, and containers.
 4. Stormwater control.
 5. Unpiped temporary toilet fixtures, wash facilities, and drinking water facilities, including disposable supplies.
 6. Temporary enclosure for building exterior, except as indicated.
 7. Temporary roads and paved areas.
 8. Dewatering facilities and drains.
 9. Excavation support and protection, unless required solely for the Work of another contract.

10. Special or unusual hoisting requirements for construction activities, including hoisting loads in excess of **2 tons (2000 kg)**, hoisting material or equipment into spaces below grade, and hoisting requirements outside building enclosure.
 11. Project identification and temporary signs.
 12. General waste disposal facilities.
 13. Pest control.
 14. Temporary stairs.
 15. Temporary fire-protection facilities.
 16. Barricades, warning signs, and lights.
 17. Site enclosure fence.
 18. Covered walkways.
 19. Security enclosure and lockup.
 20. Environmental protection.
 21. Maintenance and restoration of Owner's existing facilities used as temporary facilities.
- 1.5 ON-CALL ELECTRICAL CONTRACT (FOR DAKTRONICS ELECTRICAL INFRASTRUCTURER)
- A. Work of the Electrical Contract includes, but is not limited to, the following:
 1. Electrical and low voltage service and distribution

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 011200

SECTION 012200

UNIT PRICES

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 administrative and procedural requirements for unit prices.
- B. Related Requirements:
 - 1. Section 012100 "Allowances" for procedures for using unit prices to adjust quantity allowances.
 - 2. Section 012600 "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
 - 3. Section 014000 "Quality Requirements" for field testing by an independent testing agency.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated into the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

1.4 PROCEDURES

- A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.
- B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.
- D. List of Unit Prices: A schedule of unit prices is included in Part 3. Specification Sections referenced in the Part 3 "Schedule of Unit Prices" Article contain requirements for materials described under each unit price.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 SCHEDULE OF UNIT PRICES

- A. Unit Price No. 1: Provide temporary heat of existing Fieldhouse.
 - 1. Description: Provide 750 MBH of temporary heat to condition the fieldhouse while the existing field house infrared units are demolished, and the new roof top units are being installed and started up. Either electric or natural gas is acceptable. Contractor responsible for temporary service of power and gas piping. Temporary installations to meet all code requirements.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

2. Unit of Measurement: Provide cost on a per week basis.

END OF SECTION 012200

SECTION 033000 - CAST-IN-PLACE CONCRETE

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 cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Equipment Pads.

1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, and fly ash; subject to compliance with requirements.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
 - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 - 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

- E. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
 - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
 - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- F. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.
- G. Preinstallation Conference: Conduct conference at Project site.
 - 1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 - 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, forms and form removal limitations, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

PART 2 - PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 - 1. Plywood, metal, or other approved panel materials.
 - 2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - a. High-density overlay, Class 1 or better.
 - b. Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
 - c. Structural 1, B-B or better; mill oiled and edge sealed.
 - d. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
- B. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.
- C. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.
 3. For zinc-coated reinforcement, use galvanized wire or dielectric-polymer-coated wire bar supports.

2.4 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:
 - a. Fly Ash: ASTM C 618, Class F or C
 - B. Normal-Weight Aggregates: ASTM C 33, Class 3M coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
 - C. Water: ASTM C 94/C 94M and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
 2. Retarding Admixture: ASTM C 494/C 494M, Type B.
 3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
 4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
 6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

2.6 CURING MATERIALS

- A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.
- B. Water: Potable.

2.7 RELATED MATERIALS

- A. Bonding Agent: ASTM C 1059/C 1059M, Type II, non-redispersible, acrylic emulsion or styrene butadiene.

2.8 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.9 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Use fly ash to reduce the total amount of portland cement, which would otherwise be used, by not less than 40 percent. Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25 percent.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use concrete waterproofing admixture in all slab on grade and slab on metal deck concrete.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. As indicated on drawings.

2.11 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.12 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and 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 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. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Chamfer exterior corners and edges of permanently exposed concrete.
- H. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- K. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 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.

3.3 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50

deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.

- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 - 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
 - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

3.6 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
 - 1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 - 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 - 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- F. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- G. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.7 FINISHING FORMED SURFACES

- A. 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.

3.8 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 - 1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 - 1. Apply a trowel finish to surfaces exposed to view.
 - 2. Finish surfaces to the following tolerances, according to ASTM E 1155 (ASTM E 1155M), for a randomly trafficked floor surface:
 - a. Specified overall values of flatness, F(F) 25; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 17; and of levelness, F(L) 15.
 - 3. Finish and measure surface so gap at any point between concrete surface and an unlevelled, freestanding, 10-ft.-long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/4 inch
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations:
 - 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 - 2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 4 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 - 3. Minimum Compressive Strength: 4500 psi at 28 days.
 - 4. 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.
 - 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base, and anchor into structural concrete substrate.

6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

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 (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer 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.

3.11 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.12 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.
- 3.13 FIELD QUALITY CONTROL
- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - B. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - C. Inspections:
 1. Steel reinforcement placement.
 2. Verification of use of required design mixture.
 3. Concrete placement, including conveying and depositing.
 4. Curing procedures and maintenance of curing temperature.
 - D. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 4. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 6. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 7. Compression Test Specimens: ASTM C 31/C 31M.

- a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
13. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

END OF SECTION 033000

SECTION 051200 - STRUCTURAL STEEL FRAMING

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. Structural steel.
2. Grout.

B. Related Requirements:

1. Section 053100 "Steel Decking" for field installation of shear connectors through deck.
2. Section 055000 "Metal Fabrications" for miscellaneous steel fabrications and other steel items not defined as structural steel.
3. Section 099123 "Interior Painting"

1.3 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).

2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Mill test reports for structural steel, including chemical and physical properties.
- E. Product Test Reports: For the following:
 1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
- F. Survey of existing conditions.
- G. Source quality-control reports.
- H. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
 1. AISC 303.
 2. AISC 341 and AISC 341s1.
 3. AISC 360.
 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.

2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 1. Select and complete connections using AISC 360.
 2. Use Allowable Stress Design; data are given at service-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. W-Shapes: ASTM A 992.
- C. Channels and Angles: ASTM A 36/A 36M.
- D. Plate and Bar: ASTM A 36/A 36M.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
 1. Weight Class: Extra strong.
 2. Finish: Black except where indicated to be galvanized.
- F. Hollow Structural Sections: ASTM A500 Grade C.
- G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.
 1. Direct-Tension Indicators: ASTM F 959, Type 325 (ASTM F 959M, Type 8.8), compressible-washer type with plain finish.

2.4 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.

3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
1. Surfaces to be field welded.
 2. Surfaces of high-strength bolted, slip-critical connections.
 3. Galvanized surfaces.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils (0.038 mm). Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

- D. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils (0.038 mm).

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.
- B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

END OF SECTION 051200

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

SECTION 220000

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SECTION 220010

GENERAL PLUMBING REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 22 of the Specifications and Drawings numbered with prefixes P, MP and EP generally describe these systems, but the scope of the Plumbing work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturer's requirements and recommendations. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.
- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.

- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

IBC	International Building Code – 2018
IMC	International Mechanical Code – 2018
IPC	International Plumbing Code – 2018
IFGC	International Fuel Gas Code – 2018
IECC	International Energy Conservation Code – 2018
ADA	American Disabilities Act
AIA	Guidelines for Design and Construction of Hospital and Healthcare Facilities
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufacturers' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All Plumbing work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the Plumbing work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. **Furnish:** The term “furnish” is used to mean “supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.”
2. **Install:** The term “install” is used to describe operations at the project site including the actual “unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.”
3. **Provide:** The term “provide” means “to furnish and install, complete and ready for the intended use.”
4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
5. **Engineer:** Where referenced in this Division, “Engineer” is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary

Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".

6. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 7. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 8. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 9. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. Additional Excavation: Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. Bedding: as used in this Section refers to the compacted sand or pea gravel installed in the bottom of a pipe trench to immediately support a pipe and cover a pipe.
 3. Subbase: as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 4. Subgrade: as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 5. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
 6. Drainage Fill: as used in this Section refers to gravel installed to assist in the removal of underslab groundwater.
 7. Building Fill: as used in this section refers to borrowed fill material of rock 1" and larger used to fill foundation excavations.

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.

- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- D. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the Plumbing systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- E. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 1 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples and other submittals required by this Division as noted in Table 1 at the end of this Section. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- F. Refer to individual Sections for additional submittal requirements.
- G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before Plumbing construction starts.
- H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available

space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.

- I. Submittals shall contain the following information:
 1. The project name.
 2. The applicable specification section and paragraph.
 3. Equipment identification acronym as used on the drawings.
 4. The submittal date.
 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 6. Submittals not so identified will be returned to the Contractor without action.
- J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.
- L. Provide welders' qualification certificates.

1.8 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet. Contact the Architect for Architect's written authorization. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form. In addition to payment, Architect's written authorization and Engineer's release agreement form must be received before electronic drawing files will be sent.

1.9 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.

2. The burden of proof of the merit of the proposed substitution is upon the proposer.
3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 2. No substitution will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.10 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in Table 5.
- F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives.

1.11 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 22 of this specification. Refer to Table 2 at the end of this section for a list of specification sections in Division 22 that contain spare parts requirements.
- B. Owner or Owner's representative shall initial and date each section line in Table 2 when the specified spare parts for that section are received and shall sign at the bottom when all spare parts have been received.

1.12 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension, from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.13 TRAINING

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video tape the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.14 PAINTING

- A. Exposed ferrous surfaces, including pipe, pipe hangers, equipment stands and supports [and exposed insulated piping] shall be painted by the Plumbing Contractor using materials and methods as specified under Division 9 of the Specifications; colors shall be as selected by the Architect.
- B. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- C. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.15 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 1 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.16 GUARANTEES AND WARRANTIES

- A. Refer to Division 1 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.
- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term. Refer to Table 3 at the end of this section for a list of specification sections in Division 22 that contain special warranties.

1.17 TEMPORARY FACILITIES

- A. Refer to Division 1 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
 - 1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs
 - 2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, nonclogged condition during construction period.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
 - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
 - 2. [Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.]

1.18 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings:

1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting His bid to determine the nature and extent of work involved.
 2. Work in the existing building shall be scheduled with the Owner.
 3. Certain demolition work must be performed prior to the remodeling. The Plumbing Contractor shall perform the demolition which involves Plumbing and Plumbing systems, fixtures, equipment, piping, equipment supports or foundations and materials.
 4. Plumbing Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Plumbing Contractor during this demolition shall become his property and shall be removed by the Plumbing Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
 5. Plumbing Contractor shall relocate and reconnect Plumbing facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Plumbing equipment or materials are removed, the Plumbing Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
 6. General Contractor shall install finish material.
 7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.]
 8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect Plumbing services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- D. Use of explosives is not permitted.
- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 SOIL MATERIALS

- A. Provide clean sand, pea gravel or flowable fill material (per the geotechnical engineer's or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially crushed aggregate. Corrosive fill materials shall not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and be free of debris, waste, frozen materials, vegetable and other deleterious matter.

- C. Drainage Fill: Provide washed, evenly graded mixture of ¾" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.
- D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. (4,480 to 13,440 L/min. per sq. m) when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.1 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Plumbing Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 SELECTIVE DEMOLITION

- A. Refer to Division 01, Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.
- B. General: Demolish, remove, demount, and disconnect abandoned Plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment To Be Salvaged: Remove, demount, and disconnect existing Plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete piping, fittings and specialties, equipment, controls, fixtures and insulation.
 - a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 1, General Conditions and "Cutting and Patching" portion of this Section in Division 22.

3.4 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. The Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
 - 1. Do not allow water to accumulate in excavations and trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Plumbing Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
 - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for Plumbing installations as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.

2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:
1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below:
 2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 2. Under building slabs, use drainage fill materials.
 3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support after installation and testing of piping and prior to backfilling and placement of roadway subbase. Coordinate with AHJ for colored concrete requirements.
 5. Other areas, use excavated or borrowed materials.
- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- Q. Drainage Fill: Where building fill is used in lieu of natural soils, provide drainage fill as subbase material. Provide filter fabric material to line the trench to support the bedding material and subbase materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
- R. Placement and Compaction: Place subgrade backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- S. 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 specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

- T. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- U. Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
 - 1. Use of pneumatic backhoe as compaction method is not allowed as an acceptable process for compaction of excavations or trenches.
 - 2. For vertical and/or diagonal pipe installations greater than ½" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
 - 3. Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 - 4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
 - 5. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- V. Subsidence: Where subsidence occurs at Plumbing installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.
- W. Additional Excavation: Where additional excavation may be required due to unsuitable bearing materials encountered, notify the architect immediately for resolution.

3.5 CUTTING AND PATCHING

- A. The Contractor shall do necessary cutting of walls, floors, ceilings and roofs.
- B. No structural member shall be cut without permission from Architect.
- C. Patch around openings to match adjacent construction.

- D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Architect.

3.6 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Plumbing Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Plumbing Contractor shall clean material and equipment installed under the Plumbing Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.7 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
 - 1. Submit complete Operation and Maintenance Manuals.
 - 2. Submit complete Record Drawings.
 - 3. Perform special inspections. Refer to Table 4 at the end of this section for a list of specification sections in Division 22 that contain special inspection requirements.
 - 4. Start-up testing of systems.
 - 5. Removal of temporary facilities from the site.
 - 6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

TABLE 1: PLUMBING SPECIFICATION SHOP DRAWING SUBMITTAL REQUIREMENTS

<u>SPECIFICATION NUMBER/TITLE</u>	<u>CODE DESIGNATION</u>	
220010	General Plumbing Requirements	NONE
220015	Coordination	NONE
220500	Common Work Results For Plumbing	A, B, G, M
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B, G
220516	Expansion Fittings And Loops For Plumbing Piping	A, B, F
220519	Meters And Gauges For Plumbing Piping	B, H
220523	General-Duty Valves For Plumbing Piping	B
220529	Hangers And Supports For Plumbing Piping	B, F, G, H
220533	Heat Tracing For Plumbing Piping	A, B, E, F
220548	Seismic Controls For Plumbing Piping & Equipment	A, B, C, D, I, M
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C, F, I, J
220553	Identification For Plumbing Piping & Equipment	B, L, M
220700	Plumbing Insulation	B, M
221100	Water Distribution Piping & Specialties	B, G, H
221111	Mechanically Joined Plumbing Piping Systems	B, G, H
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	B, G, H
221113	Polypropylene Water Distribution Piping and Specialties	B, G, H
221114	Stainless Steel Water Distribution Piping and Specialties	B, G, H
221115	CPVC Water Distribution Systems & Specialties	B, G, H
221123	Domestic Water Pumps	A, B, C, E
221300	Sanitary Drainage & Vent Piping & Specialties	B
221328	Condensate Pumps For HVAC Equip	B, C, E, F
221329	Sanitary Sewerage Pumps	A, B, C, E
221400	Storm Drainage Piping & Specialties	B
221410	Siphonic Storm Drainage Piping & Specialties	A, B, I
221489	Sump Pumps	A, B, C, E
221500	General Service Compressed Air Systems	B, C, D, E, F, H
221510	Beverage System Bulk CO2 Systems	B, N
223100	Water Softeners	B, C, E, K
223120	Water Filtration Systems	B, C, E, K
223130	Copper Silver Ionization System	B, C, E, K
223140	Chlorine Dioxide System	B, C, E, K
223200	Domestic Water Filtration Equipment	B, C, E, K
223300	Electric Domestic Water Heaters	B, C, E, F, H, K
223400	Fuel Fired Domestic Water Heaters	B, C, E, F, H, K
223500	Domestic Water Heat Exchangers	B, C, E, F, H, K
224000	Plumbing Fixtures	B, E, N
226100	Gas & Vacuum Systems For Medical Facilities	B, C, E, F, G
226200	Gas & Vacuum Systems For Laboratories	B, C, E, F, G
226600	Chemical Waste Systems For Laboratory And Medical Facilities	B, C, E, F, G
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	B, C, E, F, G
227000	Natural Gas Systems	A, B, C, D, F, G
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H, N
228000	Beverage Conduit Systems	A, B, D, F
229000	Laboratory Safety Device System	B, C, E, F

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CODED LEGEND

A	Shop Drawings
B	Product Data and equipment weights
C	Performance Data, Curves, Certificates and Test Data
D	Coordination Drawings
E	Wiring Diagrams and short circuit current ratings
F	Installation Instructions
G	Welder's Certificates
H	Certificates
I	Calculations
J	Special Inspections
K	Special Warranties
L	Material Samples
M	Schedules
N	Recommended Spare Parts List

TABLE 2: SPARE PARTS REQUIREMENTS FOR PLUMBING EQUIPMENT

SECTION NUMBER	RECEIVED/DATE/INITIAL
220553	Identification For Plumbing Piping & Equipment
221100	Water Distribution Piping & Specialties
221111	Mechanically Joined Plumbing Piping Systems
221112	GENERAL PLUMBING REQUIREMENTS & Specialties
224000	Plumbing Fixtures
221123	Domestic Water Pumps
221510	Beverage System Bulk CO2 Systems
[221329	Sanitary Sewerage Pumps
[221489	Sump Pumps
223100	Water Softeners
223120	Water Filtration Systems
223130	Copper Silver Ionization System
223200	Domestic Water Filtration Equipment
223140	Chlorine Dioxide System
22610	Gas & Vacuum Systems For Medical Facilities
226200	Gas & Vacuum Systems For Laboratories
227000	Natural Gas Systems

 Owner's Signature

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TABLE 3: SPECIAL WARRANTY REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>		<u>RECEIVED/DATE/INITIAL</u>
223100	Water Softeners	_____
22320	Domestic Water Filtration Equipment	_____
223300	Electric Domestic Water Heaters	_____
223400	Fuel Fired Domestic Water Heaters	_____

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TABLE 4: SPECIAL INSPECTION REQUIREMENTS FOR PLUMBING EQUIPMENT

<u>SECTION NUMBER</u>		<u>COMPLETED/DATE/INITIAL</u>
220548	Seismic Controls For Plumbing Piping & Equipment	_____
220550	Vibration Isolation For Plumbing Piping & Equipment	_____
226100	Gas & Vacuum Systems For Medical Facilities	_____

TABLE 5: PLUMBING SPECIFICATION OPERATION AND MAINTENANCE SUBMITTAL REQUIREMENTS

SPECIFICATION NUMBER/TITLE	CODE DESIGNATION	
220500	Common Work Results For Plumbing	B
220513	Common Motor Requirements For Plumbing Equipment	B
220515	Basic Piping Materials And Methods	B
220516	Expansion Fittings And Loops For Plumbing Piping	A, B
220519	Meters And Gauges For Plumbing Piping	B, G, I
220523	General-Duty Valves For Plumbing Piping	B, H, I
220529	Hangers And Supports For Plumbing Piping	B
220533	Heat Tracing For Plumbing Piping	B, C, E, G, I
220548	Seismic Controls For Plumbing Systems	A, B, C
220550	Vibration Isolation For Plumbing Piping & Equipment	A, B, C
220553	Identification For Plumbing Piping & Equipment	B
220700	Plumbing Insulation	B
221100	Water Distribution Piping & Specialties	A, B, F, H, I
221111	Mechanically Joined Plumbing Piping Systems	A, B, F, H, I
221112	GENERAL PLUMBING REQUIREMENTS & Specialties	A, B, F, H, I
221113	Polypropylene Water Distribution Piping and Specialties	A, B, F, H, I
221114	Stainless Steel Water Distribution Piping and Specialties	A, B, F, H, I
221115	CPVC Water Distribution Systems & Specialties	A, B, F, H, I
221123	Domestic Water Pumps	B, C, D, E, G, H, I
221300	Sanitary Drainage & Vent Piping & Specialties	A, B, F
221329	Sanitary Sewerage Pumps	B, C, D, E, G, H, I
221400	Storm Drainage Piping & Specialties	A, B, F
221410	Siphonic Storm Drainage Piping & Specialties	A, B, F
221489	Sump Pumps	B, C, D, E, G, H, I
221500	General Service Compressed Air Systems	A, B, C, D, E, G, H, I
221510	Beverage System Bulk CO2 Systems	A, B, F, H
223100	Water Softeners	B, C, D, E, G, H, I
223120	Water Filtration Systems	B, C, D, E, G, H, I
223130	Copper Silver Ionization System	B, C, D, E, G, H, I
223140	Chlorine Dioxide System	B, C, D, E, G, H, I
223200	Domestic Water Filtration Equipment	B, C, E, G, H, I
223300	Electric Domestic Water Heaters	B, C, D, E, G, H, I
223400	Fuel Fired Domestic Water Heaters	B, C, D, E, G, H, I
223500	Domestic Water Heat Exchangers	B, C, E, G, I
224000	Plumbing Fixtures	B, E, H, I
226100	Gas & Vacuum Systems For Medical Facilities	A, B, C, D, E, G, H, I
226200	Gas & Vacuum Systems For Laboratories	A, B, C, D, E, G, H, I
226600	Chemical Waste Systems For Laboratory And Medical Facilities	B, C, E, F, H
226700	Process Water Piping And Equipment For Laboratory And Healthcare Facilities	A, B, C, D, E, G, H, I
227000	Natural Gas Systems	A, B, C, H
227010	Mechanically Joined Natural Gas Piping Systems	B, F, H
228000	Beverage Conduit Systems	A, B

CODED LEGEND

A As-Built Drawings

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B	Product Data
C	Performance Data, Capacities, Curves and Certificates
D	Wiring Diagrams
E	Operating Instructions
F	Test Reports
G	Warranties
H	Recommended Spare Parts List
I	Service and Maintenance Instructions

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER
Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:
Project: _____ Architect: _____
Address: _____ Owner: _____
Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
-----------------------	------	---------

Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
-------------------------------	------	---------

Engineer Review and Recommendation Section

Recommend Acceptance Yes No
 Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 220015

COORDINATION

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged plumbing equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged plumbing equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for plumbing equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Plumbing Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, the Plumbing Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "Common Work Results for Electrical" for specification of motor connections
- C. Refer to Division 26, "Enclosed Switches and Circuit Breakers" for specification of disconnect switches.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as

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indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR PLUMBING EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV 22	DIV 22	DIV 26	---
Factory furnished motor starters, contactors and disconnects	DIV 22	DIV 26	DIV 26	DIV 23
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV 26	DIV 26	DIV 26	DIV 23
Factory assembled control panels	DIV 22	DIV 26	DIV 26	DIV 23
Control relays and transformers	DIV 22	DIV 22	DIV 26	DIV 23
Thermostats (line voltage)	DIV 22	DIV 22	DIV 26	---
Time switches	DIV 22	DIV 22	DIV 26	DIV 23
Remote pressure switches (booster pumps)	DIV 22	DIV 22	---	DIV 23
Temperature control panels	DIV 22	DIV 22	DIV 26	DIV 23
Variable speed drives	DIV 22	DIV 22	DIV 26	DIV 23
Motor and solenoid operated valves	DIV 22	DIV 22	DIV 23	DIV 23
Laboratory Safety Devices	DIV22	DIV 26	DIV 26	DIV 23

DIV 22 = Plumbing Contractor

DIV 26 = Electrical Contractor

DIV 23 = Building Automation System Contractor, refer to Division 23 Section "Direct-Digital Control for HVAC".

END OF SECTION

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with Plumbing installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to Plumbing materials and equipment.
 2. Plumbing equipment nameplate data.
 3. Concrete for bases and housekeeping pads.
 4. Non-shrink grout for equipment installations.
 5. Sleeves for Plumbing penetrations.
 6. Miscellaneous metals for support of Plumbing materials and equipment.
 7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of Plumbing materials and equipment.
 8. Joint sealers for sealing around Plumbing materials and equipment.
 9. Plenum insulation for enclosure of combustible items located within fire-rated return air plenums.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 7 Section "Penetration Firestopping" for material and methods for firestopping systems.
 2. Division 22 Section "Basic piping Materials and Methods" for materials and methods for mechanical sleeve seals.
 3. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for indirect drain piping and installation requirements.
 4. Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system of leak detection system "Water Present" alarm.
 5. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 6. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 1 and Division 22 Section "General Plumbing Requirements".
1. Product data for the following products:
 - a. Access panels and doors.
 - b. Through and membrane-penetration firestopping systems.
 - c. Joint sealers.
 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for Plumbing materials and equipment.
 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.

4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 1 Section "Summary of Work."
5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

1.4 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces; noise levels due to equipment, ductwork, grilles, registers, terminal devices, diffusers, etc., shall permit attaining sound pressure levels in all 8 octave bands in occupied spaces conforming to RC levels per ASHRAE handbook as indicated.

Space RC Levels	
Sanctuary	25
Choir Risers	25
Stage	25
Sound/Lighting Control Rooms	25
A/V Spaces	25
TV Production Studio	25
Drama Theatres	25
Music Teaching Studios	25
Teleconference Rooms	25
Meeting/Banquet Rooms	30
Conference Rooms	30
Courtrooms	30

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

A. Manufacturer:

1. Bar-Co., Inc.
2. Elmdor Stoneman.
3. JL Industries
4. Jay R. Smith Mfg. Co.
5. Karp Associates, Inc.
6. Milcor
7. Nystrom Building Products
8. Wade
9. Zurn

B. Access Doors:

1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Plumbing Piping" for labeling of access doors.
2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
3. Access doors must be of the proper construction for type of construction where installed.
4. The exact location of all access doors shall be verified with the Architect prior to installation.
5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.

- a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
- 8. Locking Devices: Flush, screwdriver-operated cam locks.
- 9. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.2 PLUMBING EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated Plumbing equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted Plumbing equipment.. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have minimum heights in accordance with the following table:

Equipment	Minimum Height
Water Heaters, Water Softeners and Equipment Less than or equal to 20 tons and Other Equipment Not Listed – Note 1	3-1/2"

NOTES:

- 1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.

2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.5 PENETRATIONS

A. Sleeves:

1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.

B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

C. Box Frames: Frames for rectangular openings shall be of welded 12 gauge steel attached to forms and of a maximum dimension established by the Architect. Contractor shall notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.6 DRIP PANS

A. Drip pans for pipes in protected areas shall be 20 gauge galvanized steel with 2" lapped and soldered joints. Drip pan shall have a depth of 2" and a width of 6" in addition to the diameter of the associated pipe. Provide 3/4" galvanized pipe with male NPT outlet at low point of drip pan.

B. Drip pan supports shall be 1/4" X 2" galvanized bar stock welded to the drip pan without holes.

2.7 MISCELLANEOUS METALS

A. Steel plates, shapes, bars, and bar grating: ASTM A 36.

B. Cold-Formed Steel Tubing: ASTM A 500.

C. Hot-Rolled Steel Tubing: ASTM A 501.

D. Steel Pipe: ASTM A 53, Schedule 40, welded.

E. Fasteners: Zinc-coated, type, grade, and class as required.

2.8 MISCELLANEOUS LUMBER

A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPB rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.9 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

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. Colors: As selected by the Architect from manufacturer's standard colors.

D. Elastomeric Joint Sealers: Provide the following types:

1. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer. Provide one of the following:
 - a. "Dow Corning 790," Dow Corning Corp.
 - b. "Silglaze II SCS 2801," General Electric Co.
 - c. "Silpruf SCS 2000," General Electric Co.
 - d. "864," Pecora Corp.
 - e. "Rhodia 5C," Rhone-Poulenc, Inc.
 - f. "Spectrem 1," Tremco, Inc.
 - g. "Spectrem 2," Tremco, Inc.
 - h. "Dow Corning 795," Dow Corning Corp.
 - i. "Rhodia 7B," Rhone-Poulenc, Inc.
 - j. "Rhodia 7S," Rhone-Poulenc, Inc.
 - k. "Omniseal," Sonneborn Building Products Div.
 2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, metal or porcelain plumbing fixtures and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide one of the following:
 - a. "Dow Corning 786," Dow Corning Corp.
 - b. "Sanitary 1700," General Electric Co.
 - c. "898 Silicone Sanitary Sealant," Pecora Corp.
- E. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Provide one of the following:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Chem-Calk 600," Bostik Construction Products Div.
 - b. "AC-20," Pecora Corp.
 - c. "Sonolac," Sonneborn Building Products Div.
 - d. "Tremflex 834," Tremco, Inc.

2.10 ACOUSTICAL SEALANTS

- A. General: Penetrations by pipes through surfaces that are around and between noise critical spaces shall be sleeved, packed and sealed airtight with foam rod, non-hardening sealant and/or packing material as described herein.
- B. Foam Rod: Foam backer rod shall be closed cell polyethylene suitable for use as a backing for non-hardening sealant.
- C. Non-Hardening Sealant: Sealant for penetrations shall be non-hardening polysulphide type. Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
- D. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 pcf (40 kg/m³).

2.11 FIRESTOPPING

- A. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, or other NRTL acceptable to AHJ. Manufactured by:

1. Hilti
2. RectorSeal
3. Specified Technologies Inc.,
4. United States Gypsum Company
5. 3M Corp.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install access doors and sealants in accordance with manufacturer's installation instructions.

3.2 INSTALLATION OF ACCESS DOORS

- A. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor Plumbing materials and equipment.
- B. Select fastener sizes that will not 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 members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

- A. New Construction:
 1. Coordinate with Divisions 03 and 04 for installation of sleeves and sleeve seals integrally in cast-in-place, precast, and masonry walls and horizontal slabs where indicated on the Drawings or as required to support piping or ductwork penetrations.

- B. Construction in Existing Facilities:
 - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- C. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- D. The General Contractor will provide only those openings specifically indicated on the Architectural or Structural Drawings as being provided under the General Contractor's work.
- E. The cutting of new or existing construction shall not be permitted except by written approval of the Architect.
- F. Floor sleeves shall be fitted with means for attachment to forms and shall be of length to extend at least two inches above the floor level.
- G. Cut sleeves to length for mounting flush with both surfaces of walls.
- H. Extend sleeves installed in floors 2 inches above finished floor level.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- J. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.
- K. All openings sleeved through underground exterior walls shall be sealed with mechanical sleeve seals as specified in Division 22 Section "Basic Piping Materials and Methods".

3.8 DRIP PANS

- A. Provide drip pans in locations indicated on drawings.
- B. Provide drip pans for piping directly above a two hour rated ceiling of an elevator machine room.
- C. Provide drip pans, only with written approval obtained prior to installation, installed beneath piping above electrical rooms, telecom rooms, data rooms, servers or any other protected area not clearly indicated by drawings.
- D. Provide drip pan supports every 4'-0". Provide 1/4" galvanized threaded rods through bar stock on each side of the drip pan and attached with 2 nuts per rod. Attach rods to structure with MSS SP-58 compliant components.
- E. Connect 3/4" type "L" copper indirect drain line to drip pan outlet. Route and discharge to receptor with air gap outside of the protected area.
- F. Install leak detection rope in a zig-zag pattern covering entire length and width of the drip pan. Secure rope to pan per manufacturers recommendations.
- G. Mount leak detection controller on wall adjacent to exit of the room above which the drip pan is located unless otherwise indicated on drawings indicated on drawings.
- H. Coordinate disconnect and power supply for leak detection system and 120V dedicated receptacle adjacent to controller with Division 26. Power wiring and receptacles are specified in Division 26 Section "Common Work Results for Electrical" Disconnects are specified in Division 26 Section "Enclosed Switches and Circuit Breakers"
- I. Coordinate interlock of "Water Present" alarm and "Cable Fault alarm with Building Automation System. Refer to Division 23 Section "Direct Digital Controls for HVAC" for integration with building automation system and low voltage power wiring.

3.9 ACOUSTICAL PENETRATIONS

- A. General: There shall be no direct contact of piping with shaft walls, floor slabs and/or partition. All openings around pipes in the structure surrounding the plumbing equipment and surrounding noise-critical spaces shall be sealed, packed with caulking for the full depth of the penetration, as described herein. This includes all slab penetrations and penetrations of noise critical walls.

B. Domestic Water, Sewer, Drain and Vent Piping

1. Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. The internal diameter of the sleeve shall be 2 inches larger than the external diameter of the pipe passing through it. After all of the piping is installed in that area, the Contractor shall check the clearance and correct it, if necessary, to within 1/2 inch. Pack the void full depth with packing material sealed at both ends, 1 inch deep, with non-hardening sealant backed by foam rod.

C. Compressed Air Piping

1. Compressed air pipes may be sleeved and sealed as described above, or may be grouted and caulked into the structure as follows: before grout has set, rake a groove around the pipe on each side of the wall or slab; groove shall be 1/2 inch wide and 1/2 inch deep. After grout has set, fill groove full depth with sealant.

3.10 PLENUM INSULATION

- A. General: Plenum insulation shall be installed as a single layer encapsulation applied directly on the surface of combustible items within fire-rated return air plenums where permitted by the local authority having jurisdiction
- B. Overlap: Provide a minimum 1" perimeter and longitudinal overlap at all seams and joints. Seal all cut edges with aluminum foil tape. There shall be no exposed fiber.
- C. Secure Attachment: Securely attach insulation using stainless steel tie wire or banding at locations and intervals as recommended by the manufacturer. The entire installation shall comply with the manufacturer's written installation instructions.
- D. Approval: Plenum insulation shall not be installed where not allowed by local authority having jurisdiction. Do not install combustible material within fire-rated return air plenums where the use of plenum insulation is not approved.

END OF SECTION

SECTION 220515

BASIC PIPING MATERIALS AND METHODS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies piping materials and installation methods common to more than one Section of Division 22 and includes joining materials, piping specialties and basic piping installation instructions.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Common Work Results for Plumbing," for materials and methods for sleeve materials.

1.2 DEFINITIONS

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th 2011 Section 1417.

1.3 SUBMITTALS

- A. Refer to Division 1 and Division 22 Section "General Plumbing Requirements" for administrative and procedural requirements for submittals.
- B. Product Data: Submit product data on the following items:
 - 1. Escutcheons
 - 2. Dielectric Unions
 - 3. Dielectric Waterway Fittings
 - 4. Dielectric Flanges and Flange Kits
 - 5. Mechanical Sleeve Seals
 - 6. Wall Pipes
 - 7. Strainers
 - 8. Flexible Connectors
- C. Quality Control Submittals:
 - 1. Submit welders' certificates specified in Quality Assurance below.
- D. Submit certification that specialties and fittings for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.
- E. Submit a schedule of dissimilar metal joints and dielectric waterway fittings, unions, flanges or flange kits. Include joint type materials, connection method and proposed dielectric waterway fittings, unions and flanges to isolate dissimilar metals. Include minimum and maximum torque requirements for flange connections to valves. Refer to the individual piping system specification sections in Division 22 for specifications for piping materials and fittings relative to that particular system and additional requirements.
- F. Submit certification that fittings and specialties are manufactured in plants located in the United States or certified that they comply with applicable ANSI and ASTM standards.

1.4 QUALITY ASSURANCE

- A. Welder's Qualifications: All welders shall be qualified in accordance with ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications.
- B. Welding procedures and testing shall comply with ANSI Standard B31.9 - Standard Code for Building Services Piping and The American Welding Society, Welding Handbook.

- C. Soldering and Brazing procedures shall conform to ANSI B9.1 Standard Safety Code for Plumbing Refrigeration.
- D. Pipe specialties and fittings shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide piping materials and specialties from one of the following:
 - 1. Pipe Escutcheons:
 - a. AWI Manufacturing.
 - b. Keeney Manufacturing Company
 - c. Wal-Rich Corp.
 - d. Jones Stephens Corp.
 - 2. Dielectric Waterway Fittings:
 - a. .
 - b. Grinnell Mechanical Products; Tyco Fire Products LP
 - c. Precision Plumbing Products, Inc.
 - 3. Dielectric Unions:
 - a. JOMAR International
 - b. Smith Cooper International
 - c. Watts Regulator Co.
 - d. Zurn Industries
 - 4. Dielectric Flanges and Flange Kits:
 - a. Calpico, Inc.
 - b. FMC Technologies
 - c. Pipeline Seal & Insulator, Inc.
 - d. Tampa Rubber and Gasket Co., inc.
 - e. Watts Industries Inc.; Water Products Div.
 - f. Zurn Industries, Inc.; Wilkins Div.
 - 5. Strainers:
 - a. Armstrong Machine Works.
 - b. Hoffman Specialty ITT; Fluid Handling Div.
 - c. MEPCO
 - d. Metraflex Co.
 - e. Mueller Steam Specialties.
 - f. Nicholson Steam
 - g. RP&C Valve, Division of Conbraco Ind.
 - h. Spirax Sarco.
 - i. Watts Regulator Co.
 - 6. Mechanical Sleeve Seals:

- a. Advance Products & Systems
 - b. Calpico, Inc.
 - c. GPT Industries/Link Seal
 - d. Metraflex Co.
 - e. Proco Products, Inc.
7. Metal Flexible Connectors:
- a. United Flexible, Inc.
 - b. Hyspan
 - c. Mason Industries, Inc.
 - d. Mercer Rubber Co.
 - e. Metraflex Co.
 - f. Proco Products, Inc.
 - g. Resistoflex
 - h. Tyler Pipe; Gustin-Bacon Div.
8. Rubber Flexible Connectors:
- a. General Rubber Corp.
 - b. Mason Industries, Inc.
 - c. Mercer Rubber Co.
 - d. Metraflex Co.
 - e. Proco Products, Inc.
 - f. Uniflex, Inc.
9. Wall Pipes
- a. Josam Mfg. Co.
 - b. Smith (Jay R) Mfg. Co.
 - c. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - d. Watts Industries, Inc.
 - e. Zurn Industries, Inc.; Hydromechanics Div.

2.2 PIPE AND FITTINGS

- A. Refer to the individual piping system specification sections in Division 22 for specifications on piping and fittings relative to that particular system.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 22 Piping Sections for special joining materials not listed below.
- B. Welding Materials: AWS D10.12; Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials appropriate for the wall thickness and chemical analysis of the pipe being welded.
- C. Brazing Materials: AWS A5.8; Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials appropriate for the materials being joined.
- D. Soldering Materials: ASTM B32; Refer to individual piping system specifications for solder appropriate for each respective system.
- E. Gaskets for Flanged Joints: ASME B16.21; Gasket material shall be full-faced for cast-iron flanges and raised-face for steel flanges. Select materials to suit the service of the piping system in which installed and which conform to their respective ANSI Standard (A21.11, B16.20, or B16.21). Provide materials that will not be detrimentally affected by the chemical and thermal conditions of the fluid being carried.

2.4 PIPING SPECIALTIES

- A. Escutcheons: Chrome-plated, stamped steel, hinged, split-ring escutcheon, with set screw. Inside diameter shall closely fit pipe outside diameter, or outside of pipe insulation where pipe is insulated. Outside diameter shall completely cover the opening in floors, walls, or ceilings.
- B. Unions:
 - 1. Malleable-iron, Class 150 for low pressure service and class 300 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; female threaded ends.
 - 2. Bronze, Class 125, with lead free cast bronze body meeting ASTM B584, for low pressure service and class 250 for high pressure service; hexagonal stock, with ball-and-socket joints, metal-to-metal bronze seating surfaces; solder or female threaded ends.
- C. Dielectric Unions: Factory-fabricated with lead free cast bronze body meeting ASTM B584 and galvanized steel body with plastic dielectric gasket, class 125 for low pressure service and class 250 for high pressure service, and appropriate end connections for the pipe materials in which installed (screwed or soldered) to effectively isolate dissimilar metals, prevent galvanic action, and stop corrosion.
- D. Dielectric Waterway Fittings: Electroplated steel or brass nipple, with an inert and non-corrosive, thermoplastic lining.
- E. Dielectric Flanges and Flange Kits:
 - 1. Full faced gasket with same outside diameter and bolt hole arrangement as the flange. Pressure rating of 200psi for low pressure service and 400 psi for high pressure service at a continuous operating temperature of 180F.
 - 2. Steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.
 - 3. Lead free cast bronze meeting ASTM B584, class 125 solder type or cast iron class 125 threaded type for low pressure service and bronze class 250 solder type or cast iron class 250 threaded type for high pressure service.
- F. Y-Type Strainers: Provide strainers full line size of connecting piping, with ends matching piping system materials. Screens for 4" and smaller shall be Type 304 stainless steel mesh with 0.062" perforations and screens for 5" and larger shall be Type 304 stainless steel, with 0.125" perforations.
 - 1. For low pressure applications, cast iron strainers shall have 125 psi working pressure rating and cast bronze strainers shall have 150 psi working pressure rating. For high pressure applications, cast iron strainers shall have 250 psi working pressure rating and cast bronze strainers shall have 300 psi working pressure rating.
 - 2. Solder Ends, 2" and Smaller: Lead free cast bronze body meeting ASTM B584, screwed screen retainer with centered blowdown fitted with pipe plug.
 - 3. Flanged Ends, 2-1/2" and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
- G. Sleeves:
 - 1. Sleeve: Refer to Division 22 Section "Common Work Results for Plumbing" for sleeve materials.
- H. Mechanical Sleeve Seals: Modular Plumbing type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- I. Flexible Connectors: Fabricated from materials suitable for system fluid and that will provide flexible pipe connections.

1. Stainless-Steel-Hose, Flexible Connectors: For 2" and smaller, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples with screwed connections, welded to hose.
2. Bronze Hose, Flexible Connectors: For 2" and smaller, corrugated bronze inner tubing covered with bronze wire braid. Include ANSI 150# brass nipples with screwed connections, braised to hose.
3. Stainless-Steel-Hose, Flexible Connectors: For 2-1/2" and larger, corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include ANSI 150# 304 stainless-steel nipples or flanges, welded to hose.

2.5 WALL PIPES

- A. Cast-iron sleeve with integral clamping flange with clamping ring, bolts, and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with setscrews.

2.6 WALL SLEEVES

1. Steel sleeve of schedule 40 pipe meeting ASTM A53B with 2" wide metal plate meeting ASTM A36 welded all around. Hot dip galvanized inside and out.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's installation instructions.

3.2 PREPARATION

- A. Ream ends of pipes and tubes, and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris for both inside and outside of piping and fittings before assembly.

3.3 INSTALLATIONS

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated. Refer to individual system specifications for requirements for coordination drawing submittals.
- B. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated otherwise.
- C. Install piping free of sags and bends and with ample space between piping to permit proper insulation applications.
- D. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated on the Drawings.
- E. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1" clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- F. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- G. Support piping from structure. Do not support piping from ceilings, equipment, ductwork, conduit and other non-structural elements.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4" ball valve, and short 3/4" threaded nipple and cap.
- I. Verify final equipment locations for roughing in.

3.4 PIPING PROTECTION

- A. Protect piping during 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.

3.5 PENETRATIONS

- A. Plumbing penetrations occur when piping penetrate concrete slabs, concrete or masonry walls, or fire / smoke rated floor and wall assemblies.
- B. Above Grade Concrete or Masonry Penetrations
 - 1. Provide sleeves for pipes passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Provide schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Provide galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 10 gauge (0.1382 inches).
 - c. Provide welded galvanized sheet metal for rectangular sleeves with the following minimum metal thickness:
 - 1) For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 18 gauge (0.052 inches).
 - 2) For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 10 gauge (0.1382 inches).
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
 - 2. Extend pipe insulation for insulated pipe through floor, wall and roof penetrations, including fire rated walls and floors. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 - 3. Seal elevated floor, exterior wall and roof penetrations watertight and weathertight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2" of sealant.
- C. Underground, Exterior-Wall Penetrations: Provide galvanized steel wall sleeve. Wall sleeve is not required for existing concrete walls with core drilled penetrations. Size wall sleeves to allow for 1-inch or larger, if required by the mechanical sleeve seal manufacturer) annular clear space between pipe and sleeve. Provide mechanical sleeve seal.
 - 1. Use type and number of sealing elements recommended by manufacturer 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.
 - 2. Verify sleeve and mechanical sleeve seal installations for damage and faulty work. Verify watertight integrity of sleeves and mechanical sleeve seals installed below grade to seal against hydrostatic water pressure. If sleeve and or sleeve seal are not watertight, provide new wall sleeve and mechanical sleeve seal.
- D. Elevated Floor Penetrations of Waterproof Membrane:
 - 1. Provide cast-iron wall pipes for sleeves, extend top of wall pipe minimum 1" above finish floor. Size wall pipe for minimum 1/2" annular space between pipe and wall pipe.
 - 2. Extend pipe insulation for insulated pipe through wall pipe. The vapor barrier shall be maintained. Size wall pipe for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
 - 3. Pack with mineral wool and seal both ends with minimum of 1/2" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.

4. Secure waterproof membrane flashing between clamping flange and clamping ring. Comply with requirements for flashing specified in Division 7 Section "Sheet Metal Flashing and Trim."
 5. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- E. Interior Foundation Penetrations: Provide sleeves for horizontal pipe passing through or under foundation. Sleeves shall be cast iron soil pipe two nominal pipe sizes larger than the pipe served.
- F. Concrete Slab on Grade Penetrations:
1. Provide schedule 40 PVC pipe sleeves for vertical pressure pipe passing through concrete slab on grade. Sleeves shall be one nominal pipe size larger than the pipe served and two pipe sizes larger than pipe served for ductile iron pipes with restraining rods. Seal water-tight with silicone caulk.
 2. Provide ½" thick cellular foam insulation around perimeter of non-pressure pipe passing thru concrete slab on grade. Insulation shall extend to 2" above and below the concrete slab.
- G. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- H. Exterior Wall Penetrations: Seal annular space between sleeve and pipe or duct, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½" of waterproof sealant. Refer to Division 07 Section "Joint Sealants" for materials and installation.
1. Extend pipe insulation for insulated pipe through sleeve. The vapor barrier shall be maintained. Size sleeve for a minimum of 1" annular clear space between inside of sleeve and outside of insulation.
- I. Fire / Smoke Rated Floor and Wall Assemblies: Seal around penetrations of fire rated assemblies to maintain fire resistance rating of fire-rated assemblies. Coordinate fire ratings and locations with the architectural drawings. Install sealants in compliance with the manufacturer's UL listing. Refer to Division 22 Section "Common Work Results for Plumbing" for firestoppings and materials.
- J. Acoustical Barrier Penetrations: Where a pipe passes through a wall, ceiling or floor slab of a noise critical space, a steel sleeve shall be cast or grouted into the structure. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. The internal diameter of the sleeve shall be a minimum of 2 inches larger than the external diameter of the pipe. After the piping is installed, the Contractor shall check the clearance and correct it to within 1/2-inch. Contractor shall pack the void full depth with glass/mineral fiber insulation and seal at both ends, 1-inch deep, with sealant backed by foam rod.
1. Penetration of sound isolating ceilings by sprinkler pipes and heads shall be sleeved and sealed and shall have no rigid connections between them.
- 3.6 FITTINGS AND SPECIALTIES
- A. Use fittings for all changes in direction and all branch connections.
 - B. Remake leaking joints using new materials.
 - C. Install components with pressure rating equal to or greater than system operating pressure.
 - D. Install strainers on the supply side of each control valve, pressure reducing or regulating valve, solenoid valve, mixing valve, backflow preventer and elsewhere as indicated.

- E. Install unions at the final connection to each piece of equipment adjacent to each isolation valve or valve assembly for connections 2" and smaller. Install unions where indicated elsewhere on the drawings.
- F. Install flanges at the final connection to each piece of equipment, adjacent to each isolation valve or valve assembly in piping 2-1/2" and larger. Install flanges at each valve 2-1/2" and larger.
- G. Install dielectric unions for piping 2" and smaller or dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in dry piping systems (gas, compressed air, vacuum) for copper or brass connected to carbon steel, cast or ductile iron.
- H. Install dielectric unions for piping 2" and smaller or dielectric flanges for piping 2-1/2" and larger to connect piping materials of dissimilar metals in wet piping systems (water) (except do not install dielectric unions in concealed spaces, instead, install dielectric waterway fittings) for copper or brass connected to carbon steel, cast or ductile iron.
- I. Install dielectric waterway fittings for piping 2" and smaller for copper or brass pipe connections to carbon steel equipment connections.
- J. Install dielectric flanges for piping 2-1/2" and larger for copper or brass pipe connections to carbon steel equipment connections, steel, ductile iron or cast iron valves and fittings.
- K. Dielectric Flange Installation:
 - 1. Provide brass nipples between the equipment connection and dielectric flange for screwed connections. Provide an iron flange for the equipment side and a bronze flange for the copper or brass piping side of the joint.
 - 2. Provide a bronze flange for the copper or brass piping connection to a cast iron, ductile iron or steel flange.
 - 3. Provide full face gasket with pressure rating equal to system served.
 - 4. At each bolt provide, steel washers, thermoplastic washers and bolt isolation sleeves or thermoplastic combination washers and bolt sleeves.

3.7 JOINTS

- A. Steel Pipe Joints:
 - 1. Pipe 2" and Smaller: Thread pipe with tapered pipe threads in accordance with ANSI B2.1. Cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint lubricant or sealant suitable for the service for which the pipe is intended on the male threads at each joint and tighten joint to leave not more than 3 threads exposed.
 - 2. Pipe Larger Than 2":
 - a. Weld pipe joints (except for exterior water service pipe) in accordance with ASME Code for Pressure Piping, B31.
 - b. Weld pipe joints of exterior water service pipe in accordance with AWWA C206.
 - c. Install flanges on all valves, apparatus, and equipment. Weld pipe flanges to pipe ends in accordance with ASME B31.9 Code for Building Services Piping. Clean flange faces and install gaskets. Tighten bolts to torque specified by manufacturer of flange and flange bolts, to provide uniform compression of gaskets.
- B. Non-ferrous Pipe Joints:
 - 1. Brazed And Soldered Joints: For copper tube and fitting joints, braze joints in accordance with ANSI B31.9 - Standard Code for Building Services Piping and ANSI B9.1 - Standard Safety Code for Plumbing Refrigeration.
 - 2. Thoroughly clean tube surface and inside surface of the cup of the fittings, using very fine emory cloth, prior to making soldered or brazed joints. Wipe tube and fittings clean and apply flux. Flux shall not be used as the sole means for cleaning tube and fitting surfaces.
- C. Joints for other piping materials are specified within the respective piping system Sections.

3.8 FLEXIBLE CONNECTORS

- A. Install flexible connectors for piping system connections on equipment side of shutoff valves for all Plumbing equipment, pumps, and where indicated on Drawings.
 - 1. Install stainless steel connectors for domestic water copper equipment connections 2" and smaller.
 - 2. Install bronze connectors for non-domestic water copper equipment connections 2" and smaller.
 - 3. Install flanged stainless steel connectors for flanged equipment connections 2-1/2" and larger.
- B. Install connectors according to manufacturer's recommendations.

3.9 PIPE FIELD QUALITY CONTROL

- A. Testing: Refer to individual piping system specification sections.
- B. Inspection Report Form: Refer to the inspection report form at the end of this section for inspection data to be completed for each piping system. Submit completed forms to the Owner and Engineer.

END OF SECTION 220515

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

**PLUMBING & PLUMBING PIPING SYSTEMS
INSPECTION REPORT FORM**

Project Name: _____
Project No: _____ Contractor Project No. _____
General Contractor: _____
Inspection Date: _____ Temperature: _____

System Inspected

Building: _____
Location/Description: _____
Service: _____

Inspection Results

Time of Inspection: _____
Approval to Insulate: Y N Approval to Cover in Wall: Y N
Approval to backfill Y N

Signatures

Witness: _____ Representing: _____
Witness: _____ Representing: _____
Witness: _____ Representing: _____

Remarks

Contractor Supervisor's signature: _____

SECTION 220523

GENERAL DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes general duty valves common to most plumbing water distribution piping systems.
 - 1. Special purpose valves are specified in individual piping system specifications.

1.2 DEFINITIONS

- A. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product data, including body material, valve design, pressure and temperature classification, end connection details, seating materials, trim material and arrangement, dimensions and required clearances, and installation instructions.
- B. Submit certification that valves for domestic water distribution comply with NSF 61 Annex G and / or NSF 372.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products specified in this section from the same manufacturer where products are available and conform to the specification requirements.
- B. American Society of Mechanical Engineers (ASME) Compliance: Comply with ASME B31.9 for building services piping and ASME B31.1 for power piping.
- C. Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Compliance: Comply with the MSS Standard Practices below:
 - 1. MSS SP 67 "Butterfly Valves"
 - 2. MSS SP 70 "Gray Iron Gate Valves, Flanged and Threaded Ends"
 - 3. MSS SP 71 "Gray Iron Swing Check Valves, Flanged and Threaded Ends"
 - 4. MSS SP 72 "Ball Valves with Flanged or Butt Welding Ends"
 - 5. MSS SP 80 "Bronze Gate, Globe, Angle and Check Valves"
 - 6. MSS SP 85 "Gray Iron Globe and Angle Valves, Flanged and Threaded Ends"
 - 7. MSS SP 110 "Ball Valves, Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends"
 - 8. MSS SP 125 "Check Valves: Gray Iron and Ductile Iron, In-Line, Spring Loaded, Center-Guided"
 - 9. MSS SP 139 "Copper Alloy Gate, Globe, Angle and Check Valves for Low Pressure/Low Temperature Plumbing Applications"
- D. Valves shall be manufactured in plants located in the United States or certified that they comply with applicable ANSI, ASTM and MSS standards.
- E. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of valves containing no more than 0.25% lead by weight compliance for valves for domestic water distribution.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products from one of the manufacturers listed in valve schedule.

2.2 VALVE FEATURES, GENERAL

- A. Valve Design: Rising stem or rising outside screw and yoke stems.
 - 1. Non-rising stem valves may be used where headroom prevents full extension of rising stems.
- B. Pressure and Temperature Ratings: As scheduled and required to suit system pressures and temperatures.
- C. Sizes: Same size as upstream pipe, unless otherwise indicated.
- D. Operators: Provide the following special operator features:
 - 1. Handwheels, fastened to valve stem, for valves other than quarter turn.
 - 2. Lever handles, on quarter-turn valves 6-inch and smaller.
 - 3. Chain-wheel operators, for valves 2-1/2-inch and larger, installed 72 inches or higher above finished floor elevation. Extend chains to an elevation of 5'-0" above finished floor elevation.
 - 4. Gear drive operators, on quarter-turn valves 8-inch and larger.
- E. Extended Stems: Where insulation is indicated or specified, provide extended stems arranged to receive insulation.
- F. End Connections: As indicated in the valve specifications.
 - 1. Threads: Comply with ANSI B1.20.1.
 - 2. Flanges: Comply with ANSI B16.1 for cast iron, ANSI B16.5 for steel, and ANSI B16.24 for bronze valves.
 - 3. Solder-Joint: Comply with ANSI B16.18.
 - a. Caution: Where soldered end connections are used, use solder having a melting point below 840 deg F for gate, globe, and check valves; below 421 deg F for ball valves.

2.3 BALL VALVES

- A. Ball Valves, 2 Inch and Smaller: Meeting MSS SP 110, Class150, 600-psi CWP; two-piece construction; with ASTM B 584 cast lead free bronze, full port, blowout-proof stem and stainless steel ball, with replaceable "Teflon" or "TFE" seats and seals, solder ends and vinyl-covered steel handle.
- B. Cast Iron Body Ball Valves, 2-1/2" and larger: Meeting MSS SP 72, 200 CWP, lead free, maximum operating temperature of 140F; two piece cast iron body meeting ASTM A126 Class B with flanged ends, 304 stainless steel full port ball and shaft, ductile iron handle, FDA epoxy coating, PTFE gasket, stem seal and seat.

2.4 CHECK VALVES

- A. Swing Check Valves, 2-Inch and Smaller: Meeting MSS SP-80; Class 125, 200-psi CWP, body and cap of ASTM B 584 cast lead free bronze; with horizontal swing, Y-pattern, disc and disc holder of ASTM B 283 alloy C46400 naval brass; solder ends. Provide valves capable of being reground while the valve remains in the line.
- B. Swing Check Valves, 2-1/2-Inch and Larger: Meeting MSS SP-71 and lead free; Class 125 200-psi CWP, cast iron body and bolted cap conforming to ASTM A 126, Class B; with horizontal swing, lead free bronze disc with lead free bronze disc face ring, and bronze seat ring; and flanged ends. Provide valves capable of being refitted while the valve remains in the line.
- C. Wafer Check Valves: Meeting MSS SP 125, Class 125, 200-psi CWP, lead free cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.

- D. Wafer Check Valves: Meeting MSS SP 125, Class 250, 400-psi CWP, lead free cast-iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Provide valves designed to open and close at approximately one foot differential pressure.
- E. Lift Check Valves, 2-Inch and Smaller: Meeting MSS SP-139; 250-psi CWP, body, disc holder and cap of ASTM B 584 cast lead free bronze; horizontal or angle pattern, lift-type valve, with stainless steel spring, renewable "Teflon" disc and solder ends. Provide valves capable of being refitted and ground while the valve remains in the line.

PART 3 - EXECUTION

3.1 INSTALLATIONS

- A. Install valves in accordance with manufacturer's installation instructions.
- B. Locate valves for easy access and provide separate support where necessary. Provide access doors and fire rated access doors as required.
- C. Install valves and unions for each fixture and item of equipment arranged to allow equipment removal without system shutdown. Unions are not required on flanged devices.
- D. Install three-valve bypass around each pressure reducing valve using throttling-type valves.
- E. Install valves in horizontal piping with stem at or above the center of the pipe.
- F. Install valves in a position to allow full stem movement.
- G. Installation of Check Valves: Install for proper direction of flow as follows:
- H. Swing Check Valves: Horizontal position with hinge pin level.
- I. Wafer Check Valves: Horizontal or vertical position, between flanges.
- J. Lift Check Valve: With stem upright and plumb.

3.2 VALVE ENDS SELECTION

- A. Select valves with the following ends or types of pipe/tube connections:
 - 1. Copper Tube Size, 2-Inch and Smaller: Solder ends.
 - 2. Copper Tube Sizes 2-1/2 Inch and Larger: flanged end.

3.3 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

- A. Domestic Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	200
Butterfly	N/A	200
Gate	125	125
Globe	125	125
Check	125	125

- B. Domestic High Pressure Hot and Cold Water Service

<u>VALVE TYPE</u>	<u>2" AND SMALLER</u>	<u>2-1/2" AND LARGER</u>
Ball	150	N/A
Gate	N/A	250
Wafer Check	N/A	250

3.4 VALVE SCHEDULE

A. Ball Valves (full port – SS Ball) – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo (Conbraco)	77C-LF-240	77C-LF-140
Hammond	UP8313A	UP8303A
Milwaukee	UPBA-450S	UPBA-400S
NIBCO	S-585-66-LF	T-585-66-LF

B. Iron Body Ball Valves (full port) – 2-1/2” and larger:

<u>MANUFACTURER</u>	<u>FLANGED ENDS</u>
Apollo (Conbraco)	6PLF
Watts	G4000-FDA

C. Swing Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
Apollo	161S-LF	161T-LF
Milwaukee	UP1509	UP509
NIBCO	S-413-Y-LF	T-413-Y-LF

D. Swing Check Valves - 2-1/2 inch and larger:

<u>MANUFACTURER</u>	<u>CLASS 125</u>	<u>CLASS 175</u>
Apollo	910F-LFA	x
Milwaukee	F2974A26	x

1. x means not available.

E. Wafer Check Valves – Class 125:

<u>MANUFACTURER</u>	<u>MODEL</u>
Hammond	IR9253
Metraflex	CVOSS
Milwaukee	1400
NIBCO	W910-B-LF

Which wafers are you selecting? 125 or 250? Remove the other.

F. Wafer Check Valves – Class 250:

<u>MANUFACTURER</u>	<u>MODEL</u>
---------------------	--------------

Metraflex	CVOSS
-----------	-------

G. Lift Check Valves – 2 inch and smaller:

<u>MANUFACTURER</u>	<u>SOLDER ENDS</u>	<u>THREADED ENDS</u>
---------------------	--------------------	----------------------

Hammond	UP947	UP943
Milwaukee	UP1548T	UP548T
NIBCO	S-480-Y-LF	T-480-Y-LF

3.5 APPLICATION SCHEDULE

- A. General Application: Use gate, ball, and butterfly valves for shutoff duty; globe, ball, and butterfly for throttling duty. Refer to piping system Specification Sections for specific valve applications and arrangements.
- B. Domestic Water Systems: Use the following valve types:
 - 1. Ball Valves, 2" and Smaller: Class 150, 600-psi CWP, with stem extension if installed in insulated pipe.,.
 - 2. Ball Valves, 2-1/2" and larger: 200-psi CWP cast iron body.
 - 3. Swing Check, 2-1/2" and smaller: Class 125, cast bronze, with rubber seat.
 - 4. Check Valves, 2-1/2" and larger: Class 125, swing or wafer type as indicated.

3.6 FIELD QUALITY CONTROL

- A. Tests: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect valves for leaks. Adjust or replace packing to stop leaks; replace valves if leak persists.

3.7 ADJUSTING AND CLEANING

- A. Cleaning: Clean mill scale, grease, and protective coatings from exterior of valves and prepare valves to receive finish painting or insulation.
- B. Inspect valves for leaks after piping systems have been tested and put into service, but before final adjusting and balancing. Adjust or replace packing, as required, on valves with leaks. Replace valve if leak persists.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following:

1. Horizontal-piping hangers and supports.
2. Vertical-piping clamps.
3. Saddles and Shields.
4. Hanger-rod attachments.
5. Building attachments.
6. Spring hangers and supports.
7. Pre-engineered support strut systems
8. Pipe alignment guides.
9. Anchors.
10. Expansion Anchors.
11. Equipment supports.
1. Pre-engineered roof supports
12. Miscellaneous materials.

B. Related Sections: The following sections contain requirements that relate to this Section:

1. Division 22 Section "Plumbing Insulation", for high density insulation for protecting insulation vapor barrier and materials and methods for piping hanger installations.
2. Division 22 "Water Distribution Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical domestic water distribution and heat traced piping of sizes and materials indicated.
3. Division 22 "Sanitary Drainage & Vent Piping and Specialties", for pipe hanger types and spacing for heat traced and cold sanitary piping of sizes and materials indicated.
4. Division 22 "Storm Drainage & Piping and Specialties", for pipe hanger types and spacing for horizontal and vertical storm drainage piping of sizes and materials indicated.

1.2 DEFINITIONS

A. Terminology used in this Section is defined in MSS SP-90.

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of contract and Division 01 specification Sections.

1. Product data, including installation instructions for each type of support and anchor. Submit pipe hanger and support schedule showing Manufacturer's figure number, size, location, and features for each required pipe hanger and support.
2. Product certificates signed by the manufacturer of hangers and supports certifying that their products meet the specified requirements.
3. Welder certificates signed by Contractor certifying that welders comply with requirements specified under "Quality Assurance" Article.
4. Assembly-type shop drawings for each type of support and anchor, indicating dimensions, weights, required clearances, and methods of assembly of components.

5. Maintenance data for supports and anchors for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 22 Section "General Plumbing Requirements."
6. Submit style and type of anchors to Architect or Structural Engineer for approval prior to installation.

1.4 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Qualify welding processes and welding operators in accordance with ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."
- C. Regulatory Requirements: Comply with applicable plumbing codes pertaining to product materials and installation of supports and anchors.
- D. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Hangers, supports, and components shall be listed and labeled by a NRTL where used for fire protection piping systems. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Hangers and Supports
 1. Armacell.
 2. Anvil International.
 3. B-Line.
 4. Elite Components
 5. Halfen-DEHA.
 6. Hilti.
 7. ERICO\Michigan Hanger Co..
 8. FNW
 9. Midwest.
 10. National Pipe Hanger Corporation.
 11. Power-Strut.
 12. Truscon.
 13. Unistrut.
- B. Pre-Insulated Supports:
 1. Calcium Silicate Shield Supports:
 - a. Cooper B-Line, Inc.
 - b. Buckaroos, Inc.
 2. Pre-Engineered Thermal Hanger Inserts:
 - a. Armacell "Armafix".
 - b. Cooper B-Line, Inc.
- C. Expansion Anchors:
 1. Hilti.
 2. Phillips.
 3. Power Fasteners.

4. Rawl.

D. Pre-Engineered Roof Pipe Supports:

1. Airtec.
2. B-Line.
3. ERICO.
4. FNW
5. MIRO.
6. Roof Top Blox.

2.2 SUPPORT MATERIALS

A. Hangers and support components shall be factory fabricated of materials, design, and manufacturer complying with MSS SP-58.

1. Components shall have galvanized coatings where installed for piping and equipment that will not have field-applied finish.
2. Pipe attachments shall be copper-plated or have nonmetallic coating for electrolytic protection where attachments are in direct contact with copper tubing.
3. Components as listed below shall be made of 304 stainless steel where indicated.

2.3 SADDLES AND SHIELDS

A. Pipe Covering Protection Saddles:

1. Sheet metal construction, meeting MSS SP-58 Type 39A or B, 100-psi average compressive strength, with center rib for pipes 12" and larger. Saddles shall cover approximately one sixth of the circumference of the pipe and shall be 12" long.

B. Pre-Insulated Supports:

1. Calcium Silicate Shield Supports:
 - a. Waterproofed calcium silicate conforming to ASTM C795 encased with an insulation protection shield.
2. Pre-Engineered Thermal Hanger Inserts:
 - a. Flexible elastomeric insulation conforming to ASTM C534, Type I with integral high density pipe support.

C. Insulation Protection Shield:

1. Sheet metal construction, meeting MSS SP-69 & SP-58 Type 40, of 18 gauge for 5-1/2" inside dimension and smaller, 16 gauge for 6-1/2" to 10-3/4" inside dimension 14 gauge for 11-3/4" to 17" inside dimension, and 12 gauge for 18" to 28" inside dimension. Shield shall cover half of the circumference of the pipe and shall be of length indicated by manufacturer for pipe size and thickness of insulation.
 - a. Length: Minimum 8 inch long section at each support joint.
 - b. For pipes 2 inch and smaller using fiberglass or flexible elastomeric insulation without pre-insulated supports, provide insulation protection shields installed between hanger and pipe which meets the following minimum length requirements:

Pipe Size (NPS)	Insulation Thickness (inches)	Minimum Shield Length, (in) Hanger Spacing, (ft)					
		5	6	7	8	9	10
≤ 1	0.5	5	6	8	-	-	-
	1	3	5	5	-	-	-
	1.5	3	5	5	-	-	-
	2	3	3	3	-	-	-
	3	3	3	3	-	-	-
	0.5	8	8	11	11	12	14

	1	5	6	8	9	11	11
≤ 2	1.5	5	6	8	8	9	9
	2	5	5	6	6	8	8
	3	5	5	6	6	6	8

2. 360° Insulation Protection Shield: Shield shall cover all of the circumference of the pipe with two half circumference sections held together with bolts and nuts and shall be of length indicated by manufacturer for pipe size and thickness of insulation.

D. Hangers with pre-manufactured polymer inserts:

1. Strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts designed to receive butted insulation internally may be used in lieu of other insulated pipe support systems. Inserts shall support piping independent of insulation to avoid crushing. Installed system shall provide equal thermal and vapor barrier performance as systems with continuous unbroken insulation. Note: Metal shields are not required with clevis hangers of this type. Approved manufacturers include:
 - a. Klo-Shure.
 - b. Anvil.
 - c. Holdrite.

2.4 PRE-ENGINEERED SUPPORT STRUT SYSTEMS

- A. Support strut systems shall comply with MSS SP-69, Type 59. Shop- or field-fabricated pipe-support assembly shall be made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts. Minimum 14 gauge galvanized steel with factory-punched attachment holes. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. Long or short pipe rollers designed for use with strut system, where indicated, shall attach to the channel with brackets and nuts. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated. All nuts, brackets and clamps shall have the same finish as the channels.

2.5 PIPE ALIGNMENT GUIDES

- A. Factory fabricated, of cast semi-steel or heavy fabricated steel, consisting of bolted two-section outer cylinder and base with two-section guiding spider that bolts tightly to pipe. Length of guides shall be as recommended by manufacturer to allow indicated travel.

2.6 EXPANSION ANCHORS

- A. Self drilling, drilled flush or shell type.

2.7 PRE-ENGINEERED ROOF PIPE SUPPORTS

- A. Nominal 4" X 4" X 12" long closed cell polyethylene blocks with embedded pre-engineered support strut or pre-engineered support struts with factory plastic bases. Two piece straps shall be captivated at the shoulder when attachment nut is tightened and designed for use with strut system. All nuts, brackets and clamps shall have the same finish as the channels.

2.8 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: Conforming to ASTM A 36.
- B. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install hangers and supports in accordance with manufacturer's installation instructions.

3.2 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install hangers, supports, clamps and attachments to support piping properly from building structure.
- B. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- C. Hanger and clamps sizing:
 - 1. Cold Piping: Provide pipe hangers sized for the pipe outside diameter plus insulation thickness.
 - 2. Hot Piping: Provide pipe hangers sized for the pipe outside diameter.
 - 3. Vertical Piping: Provide clamps sized for the pipe outside diameter and extend clamp through insulation.
 - 4. Refer to Section 220700 for definition of hot and cold piping and required insulation thickness.
- D. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Install supports with maximum spacing complying with MSS SP-69. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.
- E. Install building attachments within concrete or to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- F. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- G. Field-Fabricated, Heavy-Duty Steel Trapezes: Fabricate from steel shapes selected for loads required; weld steel in accordance with AWS D-1.1.
- H. Support fire protection systems piping independently from other piping systems.
- I. Install hangers and supports to allow controlled 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ASME B31.9 Building Services Piping Code is not exceeded.
- L. Insulated Piping: Comply with the following installation requirements.
 - 1. Riser Clamps: Attach riser clamps, including spacers (if any), to piping with riser clamps projecting through insulation; do not exceed pipe stresses allowed by ASME B31.9. Do not use riser clamps to support horizontal, insulated piping. Seal insulation for hot piping and protect vapor barrier for cold piping as specified in Division 22 Section "Plumbing Insulation".
 - 2. Pipe Covering Protection Saddles: Install pipe covering protection saddles where insulation without vapor barrier is indicated. Fill interior voids with segments of insulation that match adjoining pipe insulation.
 - 3. Insulation Protection Shield: Install insulation protection shield and high density insulation where vapor barrier is indicated, sized for the insulation thickness used as specified in Division 22 Section "Plumbing Insulation".
 - a. Exception for horizontal cold piping with fiberglass or flexible elastomeric insulation 2 inch and smaller: Rest fiberglass insulated pipe on hanger shield with length specified

for pipe size and insulation thickness to prevent puncture or other damage as specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

4. Contractor's Option: Provide pre-engineered thermal hanger inserts for piping insulated with flexible elastomeric insulation at pipe supports for piping 2-1/2 inch and larger.
 5. Contractor's Option: Provide strut-mounted pipe clamps and clevis hangers with pre-manufactured polymer inserts.
- M. Pre-engineered Support Strut Systems: Channel strut systems can be used at the Contractors option in lieu of individual hangers for horizontal pipes. Space channel strut systems at the required distance for the smallest pipe supported. Provide channel gauge and hanger rods per the manufacturer's recommendations for the piping supported. Where strut systems are attached to walls, install anchor bolts per manufacturer's recommendations.
1. Uninsulated Copper Pipe: Install with plastic galvanic isolators
 2. Insulated Tube or Pipe: Install with 360° insulation protection shields or pre-engineered thermal hanger-shield inserts as specified in Division 22 Section "Plumbing Insulation".
- N. Expansion Anchors: Use in existing concrete, masonry or in pre-cast concrete construction.
- O. Pre-Engineered Roof Pipe Supports: Set supports on an 18" X 18" x 3/16" thick roof walkway material compatible with the roof material.

3.3 INSTALLATION OF PIPE ALIGNMENT GUIDES

- A. Install pipe alignment guides on piping that adjoins expansion joints, as required by expansion joint manufacturer, and elsewhere as indicated on plans and specification sections to eliminate binding and torsional stress on piping systems. Install guides per ASME B31.9 unless noted otherwise.
- B. Anchor to building substrate.

3.4 INSTALLATION OF ANCHORS

- A. Install anchors at proper locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- B. Fabricate and install anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and with AWS Standards D1.1.
- C. Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to control movement to compensators.
- D. Anchor Spacing: Where not otherwise indicated, install anchors at ends of principal pipe runs, at intermediate points in pipe runs between expansion loops and bends. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.5 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for piping and equipment.

3.6 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- 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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.7 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Touch-Up Painting: Cleaning and touch-up painting of field welds, bolted connections, and abraded areas of the shop paint on miscellaneous metal is specified in Division 9 Section "Painting".
- C. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of Plumbing work to be identified as required by this Section is indicated on drawings and/or specified in other Division 22 Sections.
- B. Types of identification devices specified in this Section include the following:
 - 1. Painted Identification Materials
 - 2. Plastic Pipe Markers
 - 3. Plastic Tape
 - 4. Underground-Type Plastic Line Marker
 - 5. Valve Tags
 - 6. Valve Schedule Frames
 - 7. Engraved Plastic-Laminate Signs
 - 8. Plastic Equipment Markers
 - 9. Plasticized Tags

1.2 CODES AND STANDARDS:

- A. ANSI Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each identification material and device required.
- B. Samples: Submit samples of each color, lettering style and other graphic representation required for each identification material or system.
- C. Schedules: Submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified in Division 1.
- D. Maintenance Data: Include product data and schedules in Maintenance Manuals as specified in Division 1 and Section "General Plumbing Requirements."

1.4 SPARE PARTS

- A. Furnish minimum of 5% extra stock of each plumbing identification material required, including additional numbered valve tags (not less than 3) for each piping system, additional piping system identification markers, and additional plastic laminate engraving blanks of assorted sizes.
 - 1. Where stenciled markers are provided, clean and retain stencils after completion of stenciling and include used stencils in extra stock, along with required stock of stenciling paints and applicators.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide plumbing identification materials of one of the following:
 - 1. Allen Systems, Inc.
 - 2. Brady (W.H.) Co.; Signmark Div.
 - 3. Industrial Safety Supply Co., Inc.
 - 4. Seton Name Plate Corp.

2.2 PLUMBING IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 22 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.3 PAINTED IDENTIFICATION MATERIALS

- A. Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications. Minimum letter height shall be 1-1/4" high letters for ductwork and 3/4" high letters for access door signs and similar operational instructions.
- B. Stencil Paint: Stencil paint shall be exterior type, oil based, alkyd enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.
- C. Identification Paint: Identification paint shall be oil based, alkyd enamel of colors indicated or, if not otherwise indicated for piping systems, comply with ANSI A13.1 for colors.

2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1
- B. Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers, complying with ANSI A13.1
- C. Insulation: Furnish 1" thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on uninsulated pipes subjected to fluid temperatures of 125 degrees F (52 degrees C) or greater. Cut length to extend 2" beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6" (including insulation if any), provide full-band pipe markers, extending 360 degrees around pipe at each location, fastened by one of the following methods:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Adhesive lap joint in pipe marker overlap.
 - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".
- E. Large Pipes: For external diameters of 6" and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than 3 times letter height (and of required length), fastened by one of the following methods:
 - 1. Laminated or bonded application of pipe marker to pipe (or insulation).
 - 2. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2" wide; full circle at both ends of pipe marker, tape lapped 3".
 - 3. Strapped-to-pipe (or insulation) application of semi-rigid type, with manufacturer's standard stainless steel bands.

- F. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.
- G. Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
- H. Lettering: Comply with piping system nomenclature as specified, scheduled, or shown, and abbreviate only as necessary for each application length.

2.5 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2" wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6", 2-1/2" wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

2.6 UNDERGROUND-TYPE PLASTIC LINE MARKER

- A. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of service of buried pipe.
 - 1. Provide multi-ply tape consisting of solid aluminum foil core between 2-layers of plastic tape.

2.7 VALVE TAGS

- A. Brass Valve Tags: Provide 19-gauge polished brass valve tags with stamp-engraved piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" diameter tags, except as otherwise indicated.
 - 2. Fill tag engraving with black enamel.
- B. Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in 1/4" high letters and sequenced valve numbers 1/2" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/2" sq. black tags with white lettering, except as otherwise indicated.
- C. Plastic Valve Tags: Provide manufacturer's standard solid plastic valve tags with printed enamel lettering, with piping system abbreviation in approximately 3/16" high letters and sequenced valve numbers approximately 3/8" high, and with 5/32" hole for fastener.
 - 1. Provide 1-1/8" sq. white tags with black lettering.
- D. Valve Tag Fasteners: Provide manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.8 ACCESS PANEL MARKERS

- A. Access Panel Markers: Provide manufacturer's standard 1/16" thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve. Include 1/8" center hole to allow attachment.

2.9 VALVE SCHEDULE FRAMES

- A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.10 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Provide engraving stock melamine plastic laminate, complying with ASTM D 709, in the sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color) except as otherwise indicated, punched for plumbing fastening except where adhesive mounting is necessary because of substrate.

- B. Thickness: 1/16" for units up to 20 sq. in. or 8" length; 1/8" for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.11 PLASTIC EQUIPMENT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color coded equipment markers. Conform to the following color code:
 - 1. Green: Cooling equipment and components.
 - 2. Yellow: Heating equipment and components.
 - 3. Yellow/Green: Combination cooling and heating equipment and components.
 - 4. Brown: Energy reclamation equipment and components.
 - 5. Blue: Equipment and components that do not meet any of the above criteria.
 - 6. For hazardous equipment, provide colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 - 1. Name and plan number.
 - 2. Equipment service.
 - 3. Design capacity.
 - 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- C. Size: Provide 2-1/2" x 4" markers for control devices, dampers, and valves; and 4-1/2" x 6" for equipment.

2.12 PLASTICIZED TAGS

- A. General: Manufacturer's standard pre-printed or partially pre-printed accident-prevention tags, of plasticized card stock with matt finish suitable for writing. Tags shall be minimum 3-1/4" x 5-5/8" in size, provided with brass grommets and wire fasteners, and with appropriate pre-printed wording including large-size primary wording (as examples; DANGER, CAUTION, DO NOT OPERATE).

2.13 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in plumbing identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of plumbing systems and equipment.
 - 1. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished plumbing spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:
 - 1. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Application: Provide piping system identification for the following systems:

1. Domestic cold water piping.
 2. Sanitary and waste piping.
 3. Storm water piping.
 4. Vent piping.
 5. Insulated and non-insulated storm water piping.
 6. Natural gas piping.
- C. Location: Install pipe markers and color bands in the following locations where piping is exposed to view, concealed only by a removable ceiling system, installed in machine rooms, installed in accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
1. Within 5 feet of each valve and control device.
 2. Within 5 feet of each branch, excluding take-offs less than 25 feet in length for fixtures; mark flow direction of each pipe at branch connection.
 3. Within 5 feet where pipes pass through walls, floors or ceilings or enter non-accessible enclosures. Provide identification on each side of wall, floor or ceiling.
 4. At access doors, manholes and similar access points which permit view of concealed piping.
 5. Within 5 feet of major equipment items and other points of origination and termination.
 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment where there are more than two piping systems or pieces of equipment.

3.3 UNDERGROUND PIPING IDENTIFICATION

- A. General: During back-filling/top-soiling of each exterior underground piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6" to 8" below finished grade. Where multiple small lines are buried in common trench and do not exceed overall width of 16", install single line marker. For tile fields and similar installations, mark only edge pipe lines of field.

3.4 VALVE IDENTIFICATION

- A. General: Provide valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibbs, and shut-off valves at plumbing fixtures and similar rough-in connections of end-use fixtures and units.
- B. List each tagged valve in valve schedule for each piping system. Mount valve schedule frames and schedules in machine rooms where indicated or, if not otherwise indicated, where directed by Architect/Engineer.
1. Where more than one major machine room is shown for project, install mounted valve schedule in each major machine room, and repeat only main valves which are to be operated in conjunction with operations of more than single machine room.

3.5 PLUMBING EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of plumbing equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
 2. Meters, gauges, thermometers and similar units.
 3. Pumps
 4. Heat exchangers
 5. Water heaters, tanks and pressure vessels.

6. Strainers, water treatment systems and similar equipment.
- B. Optional Sign Types: Where lettering larger than 1" height is needed for proper identification, because of distance from normal location of required identification, stenciled signs may be provided in lieu of engraved plastic, at Installer's option.
- C. Lettering Size: Minimum 1/4" high lettering for name of unit where viewing distance is less than 2'-0", 1/2" high for distances up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- D. Text of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.
 1. Optional Use of Plasticized Tags: At Installer's option, where equipment to be identified is concealed above acoustical ceilings or similar concealment, plasticized tags may be installed within concealed space to reduce amount of text in exposed sign (outside concealment).
 2. Operational valves and similar minor equipment items located in non-occupied spaces (including machine rooms) may, at Installer's option, be identified by installation of plasticized tags in lieu of engraved plastic signs.

END OF SECTION

SECTION 221100

WATER DISTRIBUTION PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes domestic cold water, hot water, and hot water recirculation piping, fittings, and specialties within the building to a point 5 feet outside the building.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 2 Section "Water Service Systems," for water service piping beginning from 5'-0" outside the building.
 - 3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 4. Division 22 Section "Identification, for Plumbing Piping and Equipment" for labeling and identification of water distribution piping.
 - 5. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall penetrations and equipment pads.
 - 6. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, flexible connectors, unions, dielectric unions, dielectric flanges, and mechanical sleeve seals.
 - 7. Division 22 Section "General Duty Valves for Plumbing Piping," for materials and methods for installing water distribution piping valves.
 - 8. Division 22 Section "Hangers and Supports for Plumbing Piping," for insulation shields, materials, and methods for hanging and supporting water distribution piping.
 - 9. Division 22 Section "Plumbing Insulation," for materials and methods for insulating water distribution piping.
 - 10. Division 22 Section "Sanitary Drainage and Vent Piping and Specialties," for material and methods for trap primer outlet piping.

1.2 DEFINITIONS

- A. Water Distribution Pipe: A pipe within the building or on the premises that conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Pipe: The pipe from the water main or other source of potable water supply to the water distribution pipe of the building served.
- C. Pipe sizes used in this Specification are nominal pipe size (NPS).
- D. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content $\leq 0.25\%$ per Safe Drinking Water Act as amended January 4th, 2011 Section 1417.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
 - 1. Product data for each piping specialty and valve specified.
 - 2. Welder Certificates signed by Contractor certifying that welders comply with requirements specified in Article "Quality Assurance" below.

3. Certification of Compliance with ASME and UL fabrication requirements specified in Article "Quality Assurance" below.
4. Maintenance data for each piping specialty and valve specified for inclusion in Maintenance Manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
5. Test reports specified in Part 3 of this Section.
6. Submit certification that specialties and fittings for domestic water distribution for drinking or cooking comply with NSF 61 Annex G and / or NSF 372. The following specialties need not comply:
 - a. Hose bibbs
 - b. Wall, yard, and roof hydrants

1.4 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications."
- B. Regulatory Requirements: Comply with the provisions of the following codes:
 1. ASME B31.9 "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label.
 2. ASME Boiler and Pressure Vessel Code, Section IX, "Welding and Brazing Qualifications" for Qualifications for Welding Processes and Operators.
- C. Comply with NSF 61 Annex G and / or NSF 372 for wetted surfaces of specialties and fittings containing no more than 0.25% lead by weight for domestic water distribution for drinking or cooking.
- D. Pipe, fittings, and specialties shall be manufactured in the United States or be certified to meet ASTM and ANSI standards.

1.5 SPARE PARTS

- A. Maintenance Stock: Furnish one valve key for each key-operated wall hydrant, hose bibb, fixture supply, or faucet installed.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Hose Bibbs with Vacuum Breaker:
 - a. Chicago Faucet Co.
 - b. Eljer, A Household International Company
 - c. T & S Brass & Bronze Works, Inc.
 2. Hose Bibbs:
 - a. Lee Brass Co.
 - b. Mansfield Plumbing Products
 - c. Mifab Manufacturing, Inc.
 - d. Nibco, Inc.
 - e. Prier, Inc.
 - f. Watts Regulator Co.
 - g. Woodford Mfg. Co.
 3. Wall/Yard Hydrants:
 - a. Josam Co.

- b. Mifab Manufacturing, Inc.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Prier, Inc.
 - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Drainage
 - g. Woodford Mfg. Co.
 - h. Zurn Industries Inc., Hydromechanics Div.
4. Backflow Preventers:
- a. Cla-Val Co.
 - b. Conbraco Industries, Inc.
 - c. Febco
 - d. Hersey Products, Inc.
 - e. Mifab Manufacturing, Inc./Beeco
 - f. Watts Regulator Co.
 - g. Zurn Industries Inc. Wilkins Regulator Div.
5. Relief Valves:
- a. Cash (A. W.) Valve Mfg. Corp.
 - b. Conbraco Industries, Inc.
 - c. Watts Regulator Co.
 - d. Zurn Industries, Inc. Wilkins Regulator Div.
6. Piston Type Water Hammer Arresters:
- a. Amtrol, Inc.
 - b. Josam Co.
 - c. Precision Plumbing Products, Inc.
 - d. PROFLO
 - e. Sioux Chief Manufacturing Co.
 - f. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - g. Watts Regulator Co.
 - h. Zurn Industries, Inc. Wilkins Regulator Div.
7. Trap Primers and Distribution Units
- a. Mifab Manufacturing, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. PROFLO
 - d. Sioux Chief
8. Plumbing Pipe Support Brackets
- a. Holdrite
 - b. PROFLO
 - c. Sioux Chief
9. Tube Suspension Clamps
- a. PROFLO
 - b. Sioux Chief or approved Equivalent

2.2 PIPE AND TUBE MATERIALS, GENERAL

- A. Pipe and Tube: Refer to Part 3, Articles "Above Ground Water Distribution Pipe and Fittings" or "Below Ground Water Distribution Pipe and Fittings", for identification of systems where the materials listed below are used.
- B. Copper Tube: ASTM B88, Type L Water Tube, drawn temper.
- C. Copper Tube: ASTM B88, Type K Water Tube, annealed temper.
- D. Ductile-Iron Pipe: AWWA C151 or AWWA C115 ductile-iron pipe, with AWWA C104 cement-mortar lining.
- E. PVC Plastic Service Pipe: AWWA C900, Class 100 Polyvinyl Chloride (PVC) water pipe, with belled-end fittings.
- F. Brass Pipe: Chrome Plated Schedule 40 ASTM B43 iron pipe size (IPS.)

2.3 FITTINGS

- A. Wrought Copper Solder-Joint Fittings: ANSI B16.22, streamlined pattern.
- B. Ductile-Iron Gasketed Fittings: AWWA C110 or AWWA C153, 150 psi rating, with cement mortar lining and AWWA C111 rubber gaskets.
- C. Brass Fittings: Chrome plated ANSI B16, Class 125 with threaded connections.
- D. Cast-Iron Threaded Flanges: ANSI B16.1, Class 125, raised ground face, bolt holes spot faced.
- E. Bronze Flanges: ANSI B16.24, Class 150, raised ground face, bolt holes spot faced.
- F. PVC to Ductile Iron Adapter Flanges: EBBA Iron, Inc. Series 2000PV or approved equivalent.

2.4 JOINING MATERIALS

- A. Solder Filler Metal: ASTM B32 Alloy Sb-5, 95-5 Tin-Antimony.
- B. Brazing Filler Metals: AWS A5.8, BAg Silver.
- C. Gasket Material: Thickness, material, and type suitable for fluid to be handled and design temperatures and pressures.

2.5 GENERAL-DUTY VALVES

- A. General-duty valves (i.e., gate, globe, check, ball, and butterfly valves) are specified in Division 22 Section "General Duty Valves for Plumbing Piping." Special duty valves are specified below by their generic name; refer to Part 3, Article "Valve Applications" for specific uses and applications for each valve specified.

2.6 PIPING SPECIALTIES

- A. Hose Connections: Hose connections shall have garden hose thread outlets conforming to ASME B1.20.7.
- B. Hose Bibbs: Bronze body with chrome- or nickel-plated finish, with renewable composition disc, wheel handle, 1/2- or 3/4-inch solder inlet, hose outlet.
- C. Recessed Nonfreeze Wall Hydrants: Cast-bronze box, with chrome-plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
- D. Projecting Nonfreeze Wall Hydrants: Cast-bronze, with chrome-plated face, tee handle key, vacuum breaker, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
- E. Nonfreeze Yard Hydrants: Cast-bronze hydrant, with rough bronze box, tee-handle key, drain hole, vacuum breaker, hinged locking cover, 3/4-inch inlet, and hose outlet. Bronze casing shall be length to suit depth of bury.
- F. Nonfreeze Post Hydrants: Cast-bronze hydrant, with tee-handle key, drain hole, vacuum breaker, 3/4-inch inlet, and hose outlet. Bronze casing with cast-iron casing guard shall be length to suit depth of bury.

- G. Backflow Preventers: Comply with requirements of ASSE Standard 1013 and as specified on the drawings.
- H. Pressure Reducing Valves: Comply with requirements of ASSE Standard 1003 and as specified on the drawings.
- I. Relief Valves: Sizes for relief valves shall be in accordance with ASME Boiler and Pressure Vessel Codes for indicated capacity of the appliance for which installed.
 - 1. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Temperature relief valves shall be factory set at 210 deg F, and pressure relief at 150 psi.
- J. Piston Type Water Hammer Arresters: Piston type, with casing of type "L" copper tube and spun copper ends, nylon piston with two EPDM "O"rings pressure lubricated with FDA approved silicone, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.
- K. Trap Primers: Brass construction, line pressure operation, capacity to prime number of traps as indicated with distribution units complying with requirements of ASSE Standard 1018.
- L. Pipe Support Brackets:
 - 1. Sheet Stud Bracket: 20 gauge copper with nominal copper tube holes of 1/2" on 2" centers and holes of 3/4" or 1" on 4" centers.
 - 2. Pipe Mounted Bracket: 20 gauge copper or plastic bracket with clamps for securing copper water tube and stainless steel hose clamp for securing bracket to vertical waste and vent pipe in wall.
 - 3. Carrier Bracket: 20 gauge copper bracket with 1" hole for supporting rough-in for flush valve copper tube and bolt slot for attaching to chair carrier.
- M. Tube Suspension Clamps
 - 1. Combination plastic supports and insulators for installing copper tube in stud walls with integral bracket for securing to stud with screws.

PART 3 - EXECUTION

1.1 INSTALLATION, GENERAL

- A. Install piping, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. PVC Service Pipe: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement process. After pressure testing is complete, gradually install bedding to prevent pipe deflection and then install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.
- B. Copper Tube: Provide 6" thick sand pipe bed underneath and around sides of pipe, up to middle half of the pipe. Support pipe in trench with sand bags level and true at fittings to prevent sand, gravel or debris from interfering with the brazing process. After pressure testing is complete, install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.
- C. Ductile Iron Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. 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. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe up to middle half of the pipe, including fittings. After pressure testing is

complete, provide first layer of pea gravel backfill 6" above pipe, tamp backfill with mechanical tamper and install bedding at fittings and install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 ABOVE GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type L, drawn copper tube with wrought copper fittings and solder joints for pipe sizes 8 inches and smaller, within the building.

3.4 BELOW GROUND WATER DISTRIBUTION PIPE AND FITTINGS

- A. Install Type K, soft annealed copper tube and brazed joints for pipe sizes 2 inches and smaller, with minimum number of joints, inside and outside building.

3.5 PIPING INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing and friction loss, expansion, pump sizing, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.
- G. Locate groups of pipes parallel to each other, spaced to permit applying full insulation and servicing of valves.
- H. Install drains at low points in mains, risers, and branch lines consisting of a tee fitting, 3/4-inch ball valve, and short 3/4-inch threaded nipple and cap.
- I. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- J. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves packing, and sealant. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- K. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Materials and Methods" for additional information.
- L. Install piping with 1/32-inch-per-foot (1/4 percent) downward slope towards drain point.

3.6 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shield and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Pipe Attachments: Install the following:
 - 1. Adjustable steel clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs. Provide copper coated riser clamps when in contact with copper tube.

3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Supports and Anchors" and "Plumbing Insulation".
 4. Copper coated extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of copper tube 2" and smaller on walls and for securing 1-1/4" to 2" copper tube inside walls and chases for battery fixtures. Secure clamp to the copper tube.
 - a. Seal each joint with insulation and split ring pipe to maintain the insulation barrier. Refer to Section "Plumbing Insulation" for requirement for maintenance of the vapor barrier and vapor barrier seal method.
 5. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual vertical exposed runs of stainless steel tube 2" and smaller on walls or for securing tube inside walls for connection to faucets.
 6. Support copper tube in chases and walls at plumbing fixtures with plastic or copper brackets secured to structure and U-bolts sized to bare on the pipe.
 7. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube. Provide two piece straps and 360° insulation protection shields sized for the insulation thickness used for the pipe for all insulated pipes.
 8. Provide 304 stainless steel dual rods, nuts, washers, pre-engineered support struts and split two piece pipe clamps for supporting elbows on their back, tees on their back or side under slab as detailed on the drawings. Connect rods with rebar tie wires to reinforcing bars in top layer of slab.
 9. Secure copper tube rough-in for individual fixtures with sheet stud brackets attached to the wall studs or pipe mounting brackets attached to the fixture waste & vent pipe at each plumbing fixture.
 10. Secure 1" and smaller copper water tubing in stud walls at stud penetrations with tube suspension clamps.
 - a. Cut hole through non-supporting studs with a minimum 1/8" clearance around each uninsulated copper tube or insulated copper tube.
 - b. Seal each joint of insulation and tube suspension clamp to maintain the insulation barrier. Refer to Division 22 "Plumbing Insulation" for requirement for maintenance of the vapor barrier similar to insulation butted against insulation inserts and vapor barrier seal method.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size - In.</u>	<u>Steel Pipe Max. Span - Ft.</u>	<u>Copper Tube Max. Span - Ft.</u>	<u>Min. Rod Dia. - In.</u>
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14	12	N/A	3/4
16	12	N/A	7/8

1. Support vertical steel pipe at each floor and in intervals not to exceed 15 feet.
2. Support vertical copper tube at each floor and in intervals not to exceed 10 feet.
- D. Support water piping within 12" of each elbow or tee and for water piping 2-1/2" and larger at each valve or strainer.
- E. Support water piping above the floor with pipe supports attached to the floor with anchor bolts where indicated on the drawings. Conform to the table above for maximum spacing of supports.

3.7 PIPE AND TUBE JOINT CONSTRUCTION

- A. Soldered Joints: Comply with the procedures contained in the AWS "Soldering Manual."
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 1. CAUTION: Remove stems, seats, and packing of valves and accessible internal parts of piping specialties before soldering and brazing.
 2. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 3. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ASME B1.20.1, tapered pipe threads for field-cut threads. Join pipe fittings and valves as follows:
 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
 2. Align threads at point of assembly.
 3. Apply appropriate tape or thread compound to the external pipe threads (except where dry seal threading is specified).
 4. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.
 - a. Damaged Threads: Do not use pipe with corroded or damaged threads. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Flanged Joints: Align flange surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly with a torque wrench.
- E. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Provide dielectric waterway fittings for 2" and smaller in concealed locations. Dielectric unions, waterway fittings and flanges are specified in Section "Basic Piping Materials and Methods".
- F. Joints at Valve Assemblies or Connections to Equipment: Provide unions downstream of shutoff valves at valve assemblies or equipment connections. Unions are not required at flanged connections. Unions are specified in Division 22 section "Basic Piping Materials and Methods".

3.8 SERVICE ENTRANCE

- A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building. Water service piping is specified in a separate section of Division 2.
- B. Underground exterior water distribution piping to be a depth as required by local conditions, in accordance with authority having jurisdiction's requirements and at depth no less than 18" below grade.
- C. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.
- D. Install sleeve and caulk at penetrations through building floor for watertight installation.
- E. Copper Pipe: Install Type K, soft annealed copper tube and brazed joints, with minimum number of joints, to a point 5 feet outside of building. Install changes of direction larger than the manufacturer recommended minimum bend radius to prevent kinks in the line.

3.9 VALVE APPLICATIONS

- A. General-Duty Valve Applications: The Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
1. Shut-off duty: Use gate, ball, and butterfly valves.
 2. Throttling duty: Use globe, ball, and butterfly valves.

3.10 INSTALLATION OF VALVES

- A. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2 inches and smaller, use gate or ball valves; for sectional valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
1. [For systems in excess of 200 psi, for sectional valves 2" and smaller, use ball valves; for sectional valves 2-1/2" and larger use class 250 gate valves. Provide class 250 gate valves from the lowest floor to the XXth floor.]
- B. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, on each supply to each plumbing fixture, and elsewhere as indicated. For shutoff valves 2 inches and smaller, use gate or ball valves; for shutoff valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- C. Drain Valves: Install drain valves on each plumbing equipment item, located to drain equipment completely for service or repair. Install drain valves at the base of each riser, at low points of horizontal runs, and elsewhere as required to drain distribution piping system completely. For drain valves 2 inches and smaller, use gate or ball valves; for drain valves 2-1/2 inches and larger, use ball, gate or butterfly valves.
- D. Check Valves: Install swing check valves on discharge side of each pump and elsewhere as indicated.
- E. Hose Bibbs: Install on exposed piping where indicated with vacuum breaker.
- F. Wall Hydrants: Install where indicated with vacuum breaker.

3.11 INSTALLATION OF FLOW CONTROL VALVES

- A. Install flow control valves or automatic flow control valves in each hot water recirculating loop, and elsewhere as indicated. Install a shutoff valve and strainer upstream and a union, check valve and shutoff valve downstream of each flow control or automatic flow control valve.
- B. Set flow control valve flow rate as follows:
1. Preliminary Procedures For Hot Water Return System Balancing:
 - a. Before operating the system perform these steps:
 - 1) Open valves at recirculation pump and flow control valves to full open position.
 - 2) Remove and clean all strainers.
 - 3) Check recirculation pump rotation.
 - 4) Set water heater temperature as indicated on the drawings.
 2. Procedures For Hot Water Return System Balancing
 - a. Refer to the drawings for required flow rate for each flow control valve.
 - b. Provide required instrumentation to obtain proper measurements. Instruments shall be properly maintained and protected against damage.
 - c. Apply instrument as recommended by the manufacturer.
 - d. Take readings with the eye at the level of the indicated value to prevent parallax.
 - e. Mark flow control valve setting with memory stop. Mark with paint or other suitable, permanent identification materials.
 - f. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

- C. Reports: Prepare hot water return system balancing reports signed and submit to the Architect upon completion of the project. Include the following information:
 - a. Valve tag number and description of location
 - b. Valve body size
 - c. Differential pressure reading from instrument in psi
 - d. Actual flow rate derived from the manufacturer's charts and tables for the valve size and measured differential pressure.

3.12 TRAP PRIMERS

- A. Install trap primers where indicated and where required by local authorities having jurisdiction.
- B. Connect trap primer supply line to the top of domestic cold water line no larger than 1-1/2" in diameter.
- C. Provide trap primer distribution units for trap primers serving more than one trap.
- D. Install trap primer distribution level to insure even water distribution unit to each circuit.
- E. Where applicable, adjust the trap primer for proper flow.
- F. Install trap primers a minimum of 12 inches above finished floor for every 20 feet of horizontal outlet piping to floor drains served.
- G. Install trap primers in an accessible location.
- H. Refer to Division 22 Section "Sanitary Drainage and Vent Piping and Specialties" for trap primer outlet pipe requirements.

3.13 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Install air gap fitting and pipe relief outlet drain without valves to nearest floor drain.
- B. Install pressure reducing valves with inlet and outlet shutoff valves and balance cock bypass. Install pressure gauge on valve outlet.

3.14 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by plumbing code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide shutoff valve and union for each connection; provide drain valve on drain connection. For connections 2-1/2 inches and larger, use flanges instead of unions.

3.15 FIELD QUALITY CONTROL

- A. Inspections: Inspect water distribution piping as follows:
 - 1. Do not enclose, cover, or put into operation water distribution 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 specified below 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 ensure compliance with the requirements of the plumbing code.
 - c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange for reinspection by the plumbing official.

- d. Reports: Prepare inspection reports signed by the plumbing official and turn over to the Architect upon completion of the project.
3. Reports: Prepare inspection reports and required corrective action signed by the factory-authorized service representative and turn over to the Architect upon completion of the project.
- B. Piping System Test: Test water distribution systems in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 1. Test for leaks and defects all new water distribution piping systems and parts of existing systems that 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 water distribution 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. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for 4 hours. Leaks and loss in test pressure constitute defects that must be repaired.
 4. Repair all leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
 5. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

a.

3.16 ADJUSTING AND CLEANING

- A. Clean and disinfect water distribution piping as follows:
 1. Purge all new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired prior to use.
 2. Use the purging and disinfecting procedure proscribed by the authority having jurisdiction or, in case a method is not prescribed by that authority, the procedure described in either AWWA C651, or AWWA C652, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system or part thereof and allow to stand for 24 hours.
 - c. Drain the system or part thereof of the previous solution and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean, potable water until chlorine residual is lowered to incoming city water level.
 - e. Submit water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.
 3. Reports: Prepare disinfection reports signed by the authority having jurisdiction and turn over to the Architect upon completion of the project.

3.17 COMMISSIONING

- A. Fill the system. Check compression tanks to determine that they are not air bound and that the system is completely full of water.
- B. Before operating the system, perform these steps:

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

1. Close drain valve, hydrants, and hose bibbs.
2. Open valves to full open position.
3. Remove and clean strainers.
4. Check pumps for proper direction of rotation. Correct improper wiring.
5. Lubricate pump motors and bearings.

END OF SECTION

SECTION 221300

SECTION 221300

SANITARY DRAINAGE AND VENT PIPING AND SPECIALTIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes building sanitary drainage and vent piping systems, including drains and drainage specialties.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Division 22 Section "General Plumbing Requirements," for trenching and backfilling materials and methods for underground piping installations.
 - 2. Division 33 Section "Sanitary Sewage Systems," for sanitary drainage piping beginning from 5'-0" outside the building.
 - 3. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls, and fire and smoke barriers.
 - 4. Division 11 Section "Kitchen and Food Service Equipment," for drains and trim furnished with the food service and kitchen equipment.
 - 5. Division 12 Section "Laboratory Casework and Fixtures," for laboratory drains and trim furnished with the casework.
 - 6. Division 22 Section "Plumbing Identification," for labeling and identification of drainage and vent piping.
 - 7. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations, wall and floor penetrations and equipment pads
 - 8. Division 22 Section "Basic Piping Material and Methods," for materials and methods for mechanical sleeve seals.
 - 9. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting drainage and vent piping.
 - 10. Division 22 Section "Plumbing Insulation," for materials and methods for insulating drainage piping.
 - 11. Division 22 Section "Water Distribution Piping and Specialties," for material and methods for trap primers and trap primer inlet piping.
 - 12. Division 22 Section "Condensate Pumps for HVAC Equipment," for material and methods for condensate pumps.

1.2 DEFINITIONS

- A. Sanitary Building Drain: That part of the lowest piping of a drainage system which receives the discharge from soil, waste, and other drainage pipes inside the walls of the building and conveys it to the building sewer.
- B. Sanitary Building Sewer: That part of the drainage system which extends from the end of the building drain and conveys its discharge to a public sewer, private sewer, individual sewage disposal system, or other point of disposal.
- C. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.

- D. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specifications Sections.
- B. Product data for the following products:
1. Drainage piping
 2. Drainage piping specialties
 3. Floor drains
 4. No-hub fitting restraints
- C. Test reports specified in Part 3 of this Section.

1.4 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with the provisions of the following codes:
1. 2018 International Plumbing Code

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Drainage Piping Specialties, including backwater valves, expansion joints, cleanouts, floor drains, cast-iron trench drains and vandal-proof vent caps:
 - a. Jay R. Smith Mfg. Co.
 - b. Josam Mfg. Co.
 - c. Mifab Manufacturing Co.
 - d. Sioux Chief Manufacturing Co. Inc.
 - e. Tyler Pipe/Wade Div.; Subs. of Tyler Corp.
 - f. Watts Industries, Inc.
 - g. Zurn Industries, Inc.; Hydromechanics Div.
 2. Freeze-proof vent caps:
 - a. F.J. Moore Mfg. Co.
 3. Non-Metallic Trench Drains:
 - a. ABT, Inc., Polydrain
 - b. Dura Trench
 - c. Jay R. Smith Mfg. Co.
 - d. MEA-JOSAM
 - e. Mifab Manufacturing Co.
 - f. NDS
 - g. Sioux Chief Manufacturing Co. Inc.
 - h. Watts Industries, Inc.
 - i. Zurn Industries, Inc.
 4. Heavy Duty Hubless Couplings
 - a. Anaco Husky HD-2000

- b. Clamp-All 80in. lb.
- c. Ideal Tridon "HD"
- d. Mission Rubber Company, "Heavy Weight"
- e. ProFlo "HD"
- 5. Cast Iron Soil Pipe and Fittings
 - a. AB & I Foundry
 - b. Charlotte Pipe and Foundry Company
 - c. Tyler Pipe / Soil Pipe Division
- 6. Shielded Transition Couplings
 - a. FERNCO, "Proflex 3000 Series"
 - b. Mission Rubber Company, "Band Seal Specialty Couplings"
- 7. Underground Shielded Adapter Couplings
 - a. FERNCO, "1056 Series with SR73 Shear Ring"
 - b. Mission Rubber Company, "MR56 Series"
- 8. Trap Seals
 - a. Green Drain, Inc.
 - b. Jay R. Smith Mfg. Co.
 - c. Mifab Manufacturing, Inc.
 - d. Proset Systems "Trap Guard"
 - e. Sure Seal, Inc.
 - f. Zurn Industries, Inc.; Hydromechanics Div.
- 9. Hubless Couplings:
 - a. Anaco
 - b. Ideal Tridon
 - c. Mission Rubber Company
 - d. ProFlo "PFNH"
 - e. Tyler Pipe / Soil Pipe Division
- 10. No-Hub Fitting Restraints
 - a. Holdrite
- 11. Heavy Duty Hubless Couplings for Below Slab
 - a. Anaco Husky HD-4000
 - b. Clamp-All 125in. lb.
 - c.

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: CISPI 301 and ASTM A888, no-hub pipe and fittings and bearing the trademark of CISPI and NSF.
 - 1. Couplings and compression gaskets, NSF certified: ASTM C564 and CISPI 310.
 - 2. Heavy duty couplings and compression gaskets: ASTM C1540 and meeting FM 1680.
 - a.
- B. Shielded Transition Couplings: ASTM C1460 with neoprene adapter gasket with stainless steel Shield and hose clamps.

2.3 UNDERGROUND BUILDING DRAIN AND VENT PIPE AND FITTINGS

- A. Cast-Iron Soil Pipe: ASTM A74, Service weight, hub-and-spigot soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces and bearing the trademark of CISPI and NSF.
 - 1. Neoprene Compression Gaskets: ASTM C564.
- B. Underground Shielded Adapter Couplings: ASTM C1173 with neoprene adapter gasket with stainless steel shield and stainless steel hose clamps.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Backwater Valves: Valve assembly shall be bronze fitted cast-iron, with bolted cover. Flapper shall provide a maximum 1/4 inch clearance between flapper and seat for air circulation. Valve ends shall suit piping material.
- B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- C. Cleanout Plugs: As specified on the drawings.
- D. Floor Cleanouts: As specified on the drawings.
- E. Wall Cleanouts: As specified on the drawings.
- F. Floor Drains: As specified on the drawings.
- G. Cast-iron Trench Drains: As specified on the drawings.
- H. Floor Troughs: As specified on the drawings.
- I. Freeze-Proof Vent Caps: Construct of galvanized iron, copper, or lead-coated copper, sized to provide 1 inch air space between outside of vent pipe and inside of flashing collar extension.
- J. Vandal-Proof Vent Caps: Cast-iron body full size of vent pipe, with caulked type base connection for cast-iron pipes, threaded base for steel pipes.
- K. Trap seals: Provide trap seals meeting either description below:
 - 1. Smooth, soft, flexible, elastomeric PVC material molded into shape of duck's bill, open on top with curl closure at bottom. The flow of wastewater allows duck's bill to open and adequately discharge to floor drain through its interior. The duck's bill closes and returns to original molded shape after wastewater discharge is complete. Or, smooth, soft, flexible, elastomeric PVC material with a flapper closure. The flow of wastewater allows flapper to open and adequately discharge to floor drain through its interior. The flapper closes and returns to original molded shape after wastewater discharge is complete

2.5 NO-HUB FITTING RESTRAINTS

- A. Pre-engineered kits of galvanized steel pipe straps with stainless steel band clamps and tee bolts, meeting requirements of the CISPI Installation Handbook.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install pipe and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION FOUNDATION FOR UNDERGROUND SANITARY BUILDING DRAINS

- A. Pipe Beds:
 - 1. Cast Iron Soil Pipe: Shape bottom of trench to fit bottom of pipe for 90-degrees (bottom 1/4 of the circumference). Fill unevenness with tamped sand bedding. 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 and maintain continuous pipe slope. For piping with rock trench bottoms, provide sand pipe bed 6" underneath and around sides of pipe, including fittings. After pressure testing is complete, install subbase. Refer to Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements.

3.3 PIPE APPLICATIONS - ABOVE GROUND, WITHIN BUILDING

- A. Condensate drain piping and pumped condensate drain piping inside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope gravity drainage condensate piping from mechanical equipment at 1/8" per foot minimum slope. Discharge to floor receptor with air gap.
 - 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.
- B. Condensate drain piping outside the building: Provide 3/4" minimum size or as indicated on the drawings. Slope condensate piping at 1/8" per foot minimum slope to discharge point. Discharge to roof receptors or roof drains with air gap.
 - 1. Install galvanized schedule 40 steel pipe and malleable iron fittings.
 - 2. Install Type M copper tube with wrought copper fittings with solder joints, 1" and smaller, and install Type DWV copper tube with cast copper alloy solder joint drainage fittings (DWV) fittings for 1-1/4" and larger. Provide galvanic isolators as specified in Division 22 "Basic Piping Material and Methods".
 - 3. Install PVC pressure pipe and fittings for 1" and smaller and install "solid wall" PVC Type DWV pipe and fittings for 1-1/4" and larger.
- C. Install 1/2" type L copper tube for trap primer outlet piping.

3.4 PIPE APPLICATIONS - BELOW GROUND, WITHIN BUILDING

- A. Install hub-and-spigot, service weight, cast-iron, soil pipe and fittings with gasketed joints for 15 inch and smaller for soil, waste, and vent pipe.

3.5 PIPE AND TUBE JOINT CONSTRUCTION

- A. Cast-Iron Soil Pipe: Make hubless joints in accordance with the Cast-Iron Soil Pipe & Fittings Handbook, Chapter IV. Install Couplings as followings:
 - 1. Install hubless couplings complying with CISPI 310 on soil, waste and vent piping.
 - 2. Install heavy duty hubless couplings on soil or waste stacks, soil and waste piping connections to soil or waste stacks and all soil and waste piping 4" and larger.
 - 3. Install No-Hub fitting restraints on joints 5" and larger at:
 - a. Changes of direction from vertical to horizontal
 - b. 4" branch connections, including tees, wyes and wye combination fittings to soil and waste piping 5" and larger
 - c. Horizontal changes of direction 22-1/2 degrees and greater
 - d. Changes in diameter of two pipe sizes or greater.

3.6 INSTALLATION

- A. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into consideration pipe sizing, slope, expansion, and other design considerations. So far as practical, install piping as indicated.
- B. Use fittings for all changes in direction and all branch connections.
- C. Install piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- D. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- E. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- F. Install horizontal piping as high as possible allowing for proper slope and coordination with other components. Install vertical piping tight to columns or walls. Provide space to permit insulation applications, with 1-inch clearance outside the insulation. Allow sufficient space above removable ceiling panels to allow for panel removal.

- G. Paint exposed copper drain lines serving kitchen equipment with a minimum of two coats of chromium-based paint.
- H. Exterior Wall Penetrations: Seal pipe penetrations through exterior walls using sleeves and sealer. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.
- I. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls using sleeves and mechanical sleeve sealers. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- J. Fire Barrier Penetrations: Where pipes pass through fire rated walls, partitions, ceilings and floors, maintain the fire rated integrity. Refer to Division 22 Section " Basic Piping Material and Methods" for special sealers and materials.
- K. Foundation Penetrations: Where pipes pass through foundation walls above strip footings or under strip footings, protect pipes from building load with cast iron soil pipe sleeves two pipe sizes larger than the pipe. Sleeves installed under the strip footing shall be encased in concrete.
- L. Make changes in direction for drainage and vent piping using appropriate 45 degree wyes, combination wye and eighth bend, or long sweep, quarter, sixth, eighth, or sixteenth bends. Sanitary tees or 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 pattern combination wye and eighth bends where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. Double wyes or double wye combinations shall not be used in the horizontal. 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 sized standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- M. Install underground building drains to conform with the plumbing code, and in accordance with the Cast Iron Soil Pipe Institute Engineering Manual. 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.
- N. Install drainage piping pitched down at a minimum slope of 1/4 inch per foot (2 percent) for piping 3 inch and smaller, and 1/8 inch per foot (1 percent) for piping 4 inch and larger. Install vent piping pitched to drain back by gravity to the sanitary drainage piping system.
- O. Install condensate drains pitched down at a minimum slope of 1 to 10 for piping 3 inches and smaller.
- P. Extend building drain to connect to service piping, of size and in location indicated for service entrance to building. Sewer service piping is specified in a separate section of Division 2.
- Q. Install 1 inch 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.

3.7 HANGERS AND SUPPORTS

- A. General: Hanger, support, insulation protection shields, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.
- B. Install the following pipe attachments:
 - 1. Adjustable clevis hangers, MSS SP-69 Type 1, for individual horizontal runs.
 - 2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
 - 3. Insulation protection shields and high density insulation at each hanger for insulated pipe as specified in Division 22 Sections "Hangers and Supports for Plumbing Piping" and "Plumbing Insulation".

- a. Install high density insulation on insulated pipe.
- 4. Provide vinyl coated hangers and riser clamps for use with PVC pipe.
- C. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

Nom. Pipe Size – In.	Steel Pipe Max. Span – Ft.	Copper Tube Max. Span – Ft.	Min. Rod Dia. - In.
Up to 1-1/4	12	6	3/8
1-1/2 to 2	12	10	3/8
2-1/2 to 4	12	10	3/8
5	12	10	1/2
6	12	10	1/2
8	12	10	1/2
10 to 12	12	10	5/8
14 to 15	12	N/A	3/4

Nom. Pipe Size In Inches.	CTS CPVC Tube Max. Span - Ft.	CPVC Tube Min. Rod Dia. - In.
1/2	3	3/8
3/4	3	3/8
1	3	3/8
1-1/4	4	3/8
1-1/2	4	3/8
2	4	3/8

- 1. Support all sizes of horizontal cast iron piping every five feet, except up to ten feet where ten foot sections are installed. Support all sizes of hubless horizontal cast iron piping every other joint, unless over four feet, then support each joint. Provide support adjacent to joint, not to exceed 18". Provide support at each horizontal branch.
- 2. Support all sizes of vertical cast iron piping every ten feet.
- 3. Support all sizes of vertical steel piping every other floor, not to exceed twenty-five feet.
- 4. Support all sizes of horizontal of PVC piping every four feet.
- 5. Support all sizes of vertical of PVC / CPVC piping every floor, but not to exceed ten feet. For sizes 2 inches and smaller, provide guide midway between required vertical supports.
- 6. Support vertical PVC / CPVC pipe and tube every six feet, at base of each floor, and provide mid-story guides.
- 7. Support piping within 12" of each elbow or tee.
- 8. Support each P-trap.
- D. Support condensate piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports. Adjust pipe support to maintain minimum pipe slope.

3.8 INSTALLATION OF PIPING SPECIALTIES

- A. Above Ground Cleanouts: Install in above ground piping and building drain piping as indicated, and:

1. as required by plumbing code;
 2. at each change in direction of piping greater than 45 degrees;
 3. at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping;
 4. at base of each vertical soil and waste stack.
- B. Cleanout Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- C. Floor Cleanouts: Install in below floor building drain piping as indicated, and:
1. as required by plumbing code;
 2. at each change in direction of piping greater than 45 degrees;
 3. Install in below floor building drain piping at minimum intervals of 50' for piping 4" and smaller and 75' for larger piping;
 4. Install floor cleanouts in waterproof floors with waterproof membrane securely flashed with cleanout body flashing clamp so that no leakage occurs between cleanout body and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- D. Exterior Cleanouts: Install exterior cleanouts embedded in a 18" x 18" x 8" block of concrete, flush with finished grade.
- E. Frost-Proof Vent Caps: Install frost-proof vent caps on each vent pipe passing through roof. Maintain 1 inch clearance between vent pipe and roof substrate.

3.9 INSTALLATION OF FLOOR DRAINS, FLOOR SINKS AND FLOOR TROUGHS

- A. Install floor drains, floor sinks, shower linear trench drains and floor troughs in locations indicated.
- B. Install floor drains, trench drains and shower linear trench drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor. Set floor sinks and floor troughs flush with the level finish floor.
- C. Refer to architectural documents for floor slope requirements and set floor drain elevation to match. Where architectural documents do not indicate the requirements, set the floor drain elevation depressed below the finished slab elevation as listed below to provide proper slope to drain:

<u>DEPRESSION IN INCHES</u>	<u>RADIUS OF AREA DRAINED - FEET</u>
1/2	5
3/4	10
1	15
1-1/4	20
1-1/2	25

- D. Provide P-traps for drains connected to the sanitary sewer.
- E. Install floor drains, floor sinks, shower linear trench drains, and floor troughs in waterproof floors with waterproof membrane securely flashed with drain flashing clamp so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
- F. Position drains so that they are level, accessible and easy to maintain.

3.10 INSTALLATION OF TRAP PRIMERS

- A. Install trap primer outlet piping with 1/32" per foot slope towards drain trap where possible.
- B. Connect trap primer outlet piping only to factory installed taps on the drain body or P-trap assembly or provide an auxiliary inlet fitting with factory installed trap primer tap.
- C. Install trap primer outlet piping in elevated slabs or slabs on grade below concrete reinforcing bars. Wrap with 1/2" thick flexible unicellular insulation, attach to the reinforcing bars with plastic ties and spacers every five feet to eliminate galvanic corrosion. Refer to Division 22 Section "Plumbing Insulation" for flexible unicellular insulation.

- D. Where proper trap primer outlet piping slope can be maintained and the trap primer outlet line would not be subject to freezing, trap primer outlet lines may be installed as follows:
 - 1. Install below elevated floor slabs.
 - 2. Install in the sub grade of slab on grade.
- E. Install sleeves and caulk at penetrations through building floor for watertight installation. In an elevated floor slab installation, bracket the piping to bottom of floor once the slab is poured.
- F. Refer to Division 22 Section "Water Distribution Piping and Specialties" for trap primer and trap primer inlet pipe requirements.

3.11 INSTALLATION TRAP SEALS:

- A. Install trap seals in accordance with manufacturer's written instructions and in locations indicated.
- B. Make watertight seal using an adhesive type caulk along bottom of trap seal, if required by the manufacturer.
- C. Employ a test plug for testing and remove before normal floor drain use. Clean inside of drain tailpiece and install trap seal after testing.
- D. Do not touch elastomeric plug or allow contact with primer or solvent cement.

3.12 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.13 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 specified below 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 plumbing code.
 - c. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.
 - d. Reports: Prepare inspection reports, signed by the plumbing official.
- B. Piping System Test: Test drainage and vent system in accordance with the procedures of the authority having jurisdiction, or in the absence of a published procedure, as follows:
 - 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. Rough Plumbing Test Procedure: 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. 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.

4. Final Plumbing Test Procedure: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Tightly close all openings, initially except vents thru the roof, in the system and fill the system with smoke from one or more smoke machines designed for smoke testing of plumbing systems. When smoke appears at a vent thru the roof, seal the vent thru roof with a test plug. Pressurize the system with 1" water column of smoke for 15 minutes. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Visually verify all joints for leaks.
5. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Reports: Prepare inspection reports and required corrective action signed by the plumbing official and turn over to the Architect upon completion of the project.

3.14 ADJUSTING AND CLEANING

- A. Clean interior of piping system. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.15 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.
- C. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with 2 coats of a water based latex paint.

END OF SECTION

SECTION 227000

NATURAL GAS SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes distribution piping systems for natural gas, liquid petroleum-gas and manufactured gas within the building and extending from the point of delivery to the connections with gas utilization devices. Piping materials and equipment specified in this Section include:
1. Pipes, fittings, and specialties.
 2. Special duty valves.
 3. Pressure regulators.
 4. Service meters.
- B. This Section does not apply to liquid petroleum piping; industrial gas applications using such gases as acetylene and acetylenic compounds, hydrogen, ammonia, carbon monoxide, oxygen and nitrogen; gas piping, meters, gas pressure regulators and other appurtenances used by the serving gas supplier in distribution of gas.
- C. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 22 Section "General plumbing Requirements," for trenching, excavation, backfill and compaction materials and methods for underground piping installations.
 2. Division 7 Section "Joint Sealers," for materials and methods for sealing pipe penetrations through basement and foundation walls.
 3. Division 9 Section "Painting," for materials and methods for painting pipe.
 4. Division 22 Section "Common Work Results for Plumbing," for materials and methods for fire barrier penetrations and wall and floor penetrations.
 5. Division 22 Section "Basic Piping Material and Methods," for materials and methods for strainers, unions, dielectric flanges, and mechanical sleeve seals.
 6. Division 22 Section "Hangers and Supports for Plumbing Piping," for materials and methods for hanging and supporting gas distribution piping.
 7. Division 26 Section "Common Work Results for Electrical" required electrical devices.
- D. Gas pressures for systems specified in this Section are limited to 5 psig.
- E. Products furnished under this Section include gas meters and gas service piping, which will be provided by the utility company to the site. The following is the name and address of the utility company:
- Contact: _____
Company: _____
Address: _____
Telephone number: (____) ____ - ____

1.2 DEFINITIONS

- A. Pipe sizes used in this Specification are Nominal Pipe Size (NPS).
- B. Gas Distribution Piping: A pipe within the building which conveys gas from the point of delivery to the points of usage.
- C. Gas Service Piping: The pipe from the gas main or other source of supply including the meter, regulating valve, or service valve to the gas distribution system of the building served.
- D. Point of Delivery: The outlet of the service meter assembly, or the outlet of the service regulator (service shutoff valve when no meter is provided).

1.3 SUBMITTALS

- A. Product data for each gas piping specialty and special duty valves. Include rated capacities of selected models, furnished specialties and accessories, and installation instructions.
- B. Shop drawings detailing dimensions, required clearances, for connections to gas meter.
- C. Coordination drawings for gas distribution piping systems in accordance with Division 22 Section "General Plumbing Requirements."
- D. Maintenance data for gas specialties and special duty valves, for inclusion in operating and maintenance manual specified in Division 1 and Division 22 Section "General Plumbing Requirements."
- E. Welders' qualification certificates, certifying that welders comply with the quality requirements specified under "Quality Assurance" below.
- F. Test reports specified in Part 3 below.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Installation and replacement of gas piping, gas utilization equipment or accessories, and repair and servicing of equipment shall be performed only by a qualified installer. The term qualified is defined as experienced in such work (experienced shall mean having a minimum of 5 previous projects similar in size and scope to this project), familiar with precautions required, and has complied with the requirements of the authority having jurisdiction. Upon request, submit evidence of such qualifications to the Architect.
- B. Qualifications for Welding Processes and Operators: Comply with the requirements of ASME Boiler and Pressure Vessel Code, "Welding and Brazing Qualification."
- C. Regulatory Requirements: Comply with the requirements of the following codes:
 - 1. NFPA 54 - National Fuel Gas Code, for gas piping materials and components, gas piping installation and inspections, testing, and purging of gas piping systems.
 - 2. 2018_ International Fuel Gas Code
- D. Local Gas Utility Requirements: Comply with local gas utility installation rules and regulations.
- E. Pipe, pipe fittings and pipe specialties shall be manufactured in plants located in the United States or certified to meet the specified ASTM and ANSI standards.

1.5 SPARE PARTS

- A. Valve Wrenches: Furnish to Owner, with receipt, 2 valve wrenches for each type of gas valve installed, requiring same.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide gas piping system products from one of the following:
 - 1. Gas Ball Valves – 2” and Smaller:
 - a. Apollo Valves # 77F-1XX-01
 - b. Hammond Valve # 8901
 - c. Milwaukee Valve # BA-475B
 - d. Nibco Inc. # T-FP 600A
 - e. Watts # FBV-3C
 - 2. Gas Ball Valves – 2-1/2” to 4”:
 - a. Apollo Valve # 77F-1XX-01
 - b. Hammond Valve # 8901

- c. Milwaukee Valve # BA-475B
- d. Nibco Inc. # T-FP 600A
- 3. Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing
 - a. Omegaflex, Inc. TracPipe II
- 4. Gas Relief Vents
 - a. Richards "GV Series"

2.2 PIPE AND TUBING MATERIALS

- A. General: Refer to Part 3, Article "PIPE APPLICATIONS" for identification of systems where the specified pipe and fitting materials listed below are used.
- B. Steel Pipe: ASTM A 53, Grade B, Schedule 40, (Type E electric-resistance welded or Type S seamless, black steel pipe, beveled ends).

2.3 FITTINGS

- A. Malleable-Iron Threaded Fittings: ANSI B16.3, Class 150, standard pattern, for threaded joints. Threads shall conform to ANSI B1.20.1.
- B. Steel Fittings: ASTM A 234, seamless or welded, for welded joints.
 - 1. 1-1/4" and smaller shall be socket type
 - 2. 1-1/2" and larger shall be butt weld type.
- C. Forged Steel Flanges and Flanged Fittings: ASME B16.5, Class 150, butt weld ends, standard pattern with bolts, nuts and gaskets of material group 1.1.
- D. Plastic Fittings: Medium density polyethylene socket fusion fittings, meeting ASTM D 2515 compatible with the piping system.
- E. Insect screens: Black steel body with 20 mesh stainless steel screen and MNPT end.
- F. Gas Relief Vents: Galvanized steel body with 90 degree inlet to screened outlet, 20 mesh stainless steel screen and FNPT end.

2.4 JOINING MATERIALS

- A. Brazing Filler Metals: AWS A5.8, Classification BAg-1 (Silver).
- B. Joint Compound: Suitable for the gas being handled.
- C. Gasket Material: Thickness, material, and type suitable for gas to be handled, and for design temperatures and pressures.

2.5 VALVES

- A. Gas Ball Valves – 2" and Smaller: Full port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 600 WOG, UL listed for natural gas service.
- B. Gas Ball Valves – 2-1/2" to 4": Standard port brass body with brass ball, PTFE seats, threaded ends 150psi steam, 400 WOG, UL listed for natural gas service.
- C. Solenoid Valves: As specified on the drawings.
- D. Gas Line Pressure Regulators: Single stage, steel jacketed, corrosion-resistant gas pressure regulators; with atmospheric vent, elevation compensator; internal relief vent, vent limiter for indoor installation, with threaded ends for 2 inch and smaller, flanged ends for 2-1/2 inch and larger; for inlet and outlet gas pressures, specific gravity, and volume flow as indicated on the drawings.
 - 1. CSA listed for 2 PSI gas systems
 - 2. CSA listed for 5 PSI gas systems with factory overpressure protection device.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pipe, fittings, valves and specialties in accordance with manufacturer's installation instructions.

3.2 PREPARATION

- A. Precautions: Before turning off the gas to the premises, or section of piping, turn off all equipment valves. Perform a leakage test as specified in "FIELD QUALITY CONTROL" below, to determine that all equipment is turned off in the piping section to be affected.
- B. Conform with the requirements in NFPA 54, for the prevention of accidental ignition.

3.3 PREPARATION FOUNDATION FOR UNDERGROUND GAS SERVICE PIPING

- A. Pipe Beds for Pre-sleeved Vent Capable Semi-rigid Corrugated Stainless Steel Tubing, PE Pipe and PVC Pipe Conduit: Support pipe in trench with sand bags level and true to prevent sand, gravel or debris from interfering with the solvent cement or fusion process. After pressure testing is complete, gradually install bedding to maintain continuous pipe slope and prevent pipe deflection and then install subbase. Refer to Division 22 Section "General Plumbing Requirements" for bedding and subbase materials, excavation, trenching, backfill and compaction requirements and refer to ASTM D2321 "Underground Installation of Thermoplastic Pipe for Sewers and Gravity-flow Applications" for additional requirements.

3.4 PIPE APPLICATIONS

- A. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger.
- B. Install PE plastic pipe with fusion bond plastic fittings below grade outside the building slab.

3.5 PIPING INSTALLATION

- A. General: Conform to the requirements of NFPA 54 - National Fuel Gas Code.
- B. Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of piping systems. Design locations and arrangements of piping take into consideration pipe sizing, flow direction, slope of pipe, expansion, and other design considerations. So far as practical, install piping as indicated.
- C. Concealed Locations: As specified below:
 - 1. Inaccessible Above-Ceiling Locations: Install concealed gas piping in inaccessible above-ceiling spaces without valves or unions.
 - 2. Accessible Above-Ceiling Locations: Gas piping may be installed in accessible above-ceiling spaces (subject to the approval of the authority having jurisdiction), whether or not such spaces are used as a plenum. Valves and unions shall not be located in such spaces used as a plenum.
 - 3. In Floors: Install concealed gas piping in concrete floor slabs in an air-tight conduit constructed of Schedule 40 PVC with socket weld joints two pipe sizes larger than the gas pipe served. Extend conduit a minimum of 12" above finish floor and cap air tight at both ends. Vent conduit to the outside with a minimum 2" pipe and terminate with a screened vent cap.
 - 4. Piping In Partitions: Install concealed gas piping in hollow partitions with welded joint (subject to the approval of the authority having jurisdiction) and protect gas piping against physical damage. Install gas piping passing through partitions with no joints or unions inside the partition.
 - 5. Concrete or Masonry Walls: Do not install gas piping in masonry or concrete walls.
 - 6. Prohibited Locations: Do not install gas piping in or through a circulating air duct, clothes chute, chimney or gas vent, ventilating duct, dumbwaiter or elevator shaft. This does not apply to accessible above-ceiling space specified above.

- D. Fire Barrier Penetrations: Where pipes pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity. Refer to Division 22 Section "Common Work Results for Plumbing" for special sealers and materials.
- E. Elevated Floor Penetrations of Waterproof Membrane, Interior Penetrations of No-Fire Rated Walls and Concrete Slab on Grade Penetrations: Provide sleeves and seal pipes that pass through waterproof floors, non-fire rated walls, partitions and ceilings or concrete slab on grade. Refer to Division 22 Section "Basic Piping Materials and Methods" for special sealers and materials.
- F. Exterior Wall Penetrations: Seal pipe penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 22 Section "Common Work Results for Plumbing" for additional information.
- G. Underground Exterior Wall Penetrations: Seal pipe penetrations through underground exterior walls with sleeves and mechanical sleeve seals. Refer to Division 22 Section "Basic Piping Material and Methods" for additional information.
- H. Dirt legs and Sediment Traps: Install a dirt leg at points where condensate and impurities may collect, at the outlet of the gas meter, as close to the inlet of each gas appliance or equipment as possible, and in a location readily accessible to permit cleaning and emptying.
 - 1. Construct dirt legs and sediment traps using a tee fitting with the bottom outlet plugged or capped. Provide a 3" length of pipe and screwed cap for the dirt leg. Use line size pipe for dirt leg, refer to the drawings for sizes. Enter the tee with flow from the top and exit the tee from the side outlet. Install the dirt leg a minimum of 3-1/2" above the roof or floor readily accessible to permit cleaning and emptying.
 - 2. Install line size gas cock, union and dirt leg at each equipment connection; refer to the drawings for sizes. Provide reducers at the equipment connection as required. Unions are specified in Division 22 section "Basic Piping Materials and Methods".
- I. Use fittings for all changes in direction and all branch connections.
- J. Install exposed piping at right angles or parallel to building walls. Diagonal runs are not permitted, unless expressly indicated.
- K. Install piping free of sags or bends and with ample space between piping to permit proper insulation applications.
- L. Conceal all pipe installations in walls, pipe chases, utility spaces, above ceilings, below grade or floors, unless indicated to be exposed to view.
- M. Install horizontal piping as high as possible allowing for specified slope and coordination with other components. Install vertical piping tight to columns or walls. Allow sufficient space above removable ceiling panels to allow for panel removal.
- N. Locate groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.
- O. Install gas piping at a uniform grade of 1/4 inch in 15 feet, upward to risers, and from the risers to the meter, or service regulator when meter is not provided, or the equipment.
- P. Make reductions in pipe sizes using eccentric reducer fittings installed with the level side down.
- Q. Connect branch outlet pipes from the top or sides of horizontal lines, not from the bottom.
- R. Install unions in pipes 2 inch and smaller, adjacent to each valve, and elsewhere as indicated. Unions are not required on flanged devices. Unions are specified in Section "Basic Piping Materials and Methods".
- S. Joints Containing Dissimilar Metals: Provide dielectric unions for 2" and smaller and dielectric flanges for piping 2-1/2" and larger. Dielectric unions and flanges are specified in Section "Basic Piping Materials and Methods".
- T. Install flanges on valves, apparatus, and equipment having 2-1/2 inch and larger connections.

- U. Install strainers on the supply side of each control valve, pressure reducing valve, pressure regulating valve, solenoid valve, and elsewhere as indicated.
- V. Anchor piping to ensure proper direction of expansion and contraction. Install expansion loops and joints as indicated on the Drawings and specified in Division 22 Section "Expansion Fittings and Loops for Plumbing Piping."
- W. Paint Exposed Outdoor Gas Piping: Cleaning and painting of exposed outdoor gas piping is specified in Division 9 Section "Painting".
 - 1. Final color per the architect.
- X. Semi-rigid Corrugated Stainless Steel Tubing:
 - 1. Install through floors, walls and ceilings with an opening at least ½" larger than the outside diameter of the tubing.
 - 2. Install changes in direction with a minimum bend radius per the manufacturer's recommendations to avoid over stressing the tubing or fittings. Replace tubing that has been installed with tight bends, kinks, twists or stretches with new.
 - 3. Provide striker plates within 3" of joist, ceiling, or floor and per the manufacturer's recommendations to protect tubing installed beneath, or along floor support members or through floor support members to protect concealed piping from puncture.
 - 4. Install tubing within partition walls between wall studs hanging freely and provide striker plates where the tubing is attached or constrained at studs or other retaining type structures to prevent the possibility of being punctured by a 3" long nails.
 - 5. Install termination outlets with sufficient clearance from ceilings, walls and floors to permit the use of a suitably sized pipe wrench without straining or bending the tubing. Provide a strike plate or encase the tubing in a strike protection hose to protect the tubing where movement is restricted due to the termination outlet. Concealed fittings are permitted when the piping is installed within a strike protection hose.
 - 6. Install tubing under concrete slab on grade within buildings provide with either factory installed pre-sleeved vent pipe or conduit at least ½" larger than the outside diameter of the tubing. Install tubing underslab as one piece, with no splices - concealed fittings are not permitted. Tubing is not permitted to be directly embedded within concrete.
 - 7. Install tubing underground outside of building and provide with either factory installed pre-sleeved vent pipe or conduit at least ½" larger than the outside diameter of the tubing. Provide minimum burial depth of 18". Install conduit to extend 12" minimum above grade. Install tubing underground as one piece, with no splices - concealed fittings is not permitted. Attach to the building or structure within 12" of entering or leaving conduit. Provide a support post where the building or structure is not available for support.
 - 8. Provide a pipe sleeve at least ½" larger than the outside diameter of the tubing within 6 feet of floor / grade to protect exposed piping either inside building or outside building.
 - 9. Fittings with auto-flare ends with stainless steel inserts: Provide shrink sleeves at mechanical joints and associated exposed metal tubing for protection from damage.
 - 10. Fittings with double wall flare with Jacket Lock™, mechanical capture of the jacket: Secure jacket with fitting at mechanical joints. Where jacket is not captured by fitting, provide shrink sleeves at associated exposed metal tubing for protection from damage.
 - 11. Provide transition fittings for steel to tubing in accessible location to permit visual inspection.
 - 12. Tubing is not approved for installation as a gas appliance connector for final connection to movable gas appliances or equipment. Do not directly connect tubing to either movable or non-movable equipment or appliances.
 - 13. Install tubing underslab inside of building with pre-sleeved vent capable semi-rigid corrugated stainless steel tubing. Provide minimum burial depth of 18". Install tubing

underground as one piece, with no splices - concealed fittings is not permitted. Extend to above slab 12" above floor at both ends.

- a. Provide copper tube vent with braised joints from vent connection in pre-sleeved vent capable semi-rigid corrugated stainless steel tubing to the outdoors where indicated on the drawings.
- Y. Install plastic pipe underground with socket weld plastic joints. Use transition fittings for joining steel to plastic pipe. Installation and pipe bedding shall be per the manufacturer's published installation recommendations.

3.6 HANGERS AND SUPPORTS

A. General: Hanger, support, and anchor components and installation procedures conforming to MSS SP-58 and SP-69 are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table below for maximum spacing of supports.

B. Pipe Attachments: Install the following:

1. Adjustable clevis hangers, MSS SP-69 Type 1, for steel pipe 2-1/2" and larger for individual horizontal runs.
2. Riser clamps, MSS SP-69 Type 8, for individual vertical runs.
3. Extension split ring pipe clamp, MSS SP-69 Type 12, for individual exposed runs on walls.
4. Engineered strut support system may be provided, at the contractor's option, in lieu of individual hangers for horizontal pipes as specified in Division 22 "Hangers and Supports for Plumbing Piping". Provide two piece straps for uninsulated pipe secured to the bare pipe and provide plastic galvanic isolators for bare copper tube.
5. Install hangers with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58 and SP-69, locally enforced codes, this specification, and authorities having jurisdiction requirements, whichever are most stringent. Install hangers for horizontal piping with the following maximum spacing and minimum rod diameters:

<u>Nom. Pipe Size in Inches</u>	<u>Max Span In Feet</u>	<u>Min. Rod Dia. - Inches</u>
1/2	6	3/8
3/4 to 1	8	3/8
1-1/4 to 2	10	3/8
2-1/2 to 3	10	3/8
4	10	3/8
6	10	1/2
8	10	3/4

6. Support semi-rigid corrugated stainless steel tubing with the following maximum spacing:

<u>Nom. Pipe Size in Inches</u>	<u>Max Horizontal Span - In Feet</u>	<u>Max Vertical Span - In Feet</u>	<u>Min. Rod Dia. - Inches</u>
1/2	4	10	3/8
3/4	6	10	3/8
1 to 2	8	10	3/8

- C. Support vertical piping at every floor.
- D. Support gas piping within 12" of each elbow or tee and for gas piping 2-1/2" and larger at each valve or pressure regulator.
- E. Support gas piping located on the roof with 4" x 4" x 12" long ACQ rot-proof treated timber blocks. Rot-proof timber blocks are specified in Division 22 Section "Hangers and Supports for Plumbing Piping". Conform to the table above for maximum spacing of supports.
- F. Support gas piping located on roof with pre-engineered roof supports, pre-engineered roof supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping".

Conform to the table above for maximum spacing of supports. Support pipe at a minimum 7" above the roof.

- G. Support semi-rigid corrugated stainless steel tubing located on the roof with strut/channel from support to support, running parallel beneath the pipe.

3.7 PIPE JOINT CONSTRUCTION

- A. Welded Joints: Comply with the requirements in ASME Boiler and Pressure Vessel Code, Section IX.
- B. Brazed Joints: Comply with the procedures contained in the AWS "Brazing Manual."
 - 1. **WARNING:** Some filler metals contain compounds which produce highly toxic fumes when heated. Avoid breathing fumes. Provide adequate ventilation.
 - 2. **CAUTION:** Remove stems, seats, and packing of valves, and accessible internal parts of piping specialties before brazing.
 - 3. Fill the tubing and fittings during brazing with an inert gas (nitrogen or carbon dioxide) to prevent formation of scale.
 - 4. Heat joints to proper and uniform temperature.
- C. Threaded Joints: Conform to ANSI B1.20.1, tapered pipe threads for field cut threads. Join pipe, fittings, and valves as follows:
 - 1. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint. Refer to NFPA 54, for guide for number and length of threads for field threading steel pipe.
 - 2. Align threads at point of assembly.
 - 3. Apply thread compound for use with gas systems to the external pipe threads. Pipe thread tape is not accepted.
 - 4. Assemble joint to appropriate thread depth. When using a wrench on valves place the wrench on the valve end into which the pipe is being threaded.
 - 5. **Damaged Threads:** Do not use pipe with threads which are corroded, or damaged. If a weld opens during cutting or threading operations, that portion of pipe shall not be used.
- D. Flanged Joints: Align flanges surfaces parallel. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly to appropriate torque specified by the bolt manufacturer.
- E. Fusion Welded: Joints shall be made by a qualified and approved operator in accordance with Title 49, CFR, Part 192.283 and be made in accordance with pipe manufacturer's recommendations.
- F. Semi-rigid Corrugated Stainless Steel Tubing: Joints shall be made by a qualified and approved operator in accordance with pipe manufacturer's recommendations.

3.8 VALVE APPLICATIONS

- A. General: The Drawings indicate valve types, locations, and arrangements.
- B. Shut-off duty: Use gas cocks specified in Part 2 above.

3.9 VALVE INSTALLATIONS

- A. Install valves in accessible locations, protected from physical damage. Tag valves with a metal tag attached with a metal chain indicating the piping systems supplied.
- B. Install line size gas cock at the outlet of the gas meter set or gas riser and install a line size union downstream of the gas cock outside of the building.
- C. Installation of Gas Pressure Regulators:

1. Install a gas cock 10 pipe diameters upstream of each gas pressure regulator. Where two gas pressure regulators are installed in series in a single gas line, a manual valve is not required at the second regulator.
2. Install line pressure regulators a minimum of 10 pipe diameters upstream of each atmospheric or power burner equipment connection.
3. Install line pressure regulators a minimum of 10'-0" upstream of each condensing boiler or water heater connection.
4. Install gas pressure regulator relief devices so they can be readily operated to determine if the valve is free; so they can be tested to determine the pressure at which they will operate; and examined for leakage when in the closed position.
5. Install gas pressure regulators with listed vent limiters indoors where allowed by the AHJ. Install with regulator dome vertically upright and level.
6. Install gas pressure regulators located outside the building with the relief port facing down to prevent the entry of moisture with the relief port a minimum of 18" above the roof or finish grade. Remove vent limiter and provide with line size (same size as gas vent relief port) insect screen or gas relief vent and 1" long schedule 40 black steel nipple.
 - a. Where manufacturer does not allow the gas pressure regulator to be installed upside down, install gas pressure regulator with regulator dome in the horizontal or vertically upright with factory breather plug.
7. Gas Pressure Regulator Relief Vents: Provide for gas pressure regulators that require them or for vent less regulators where the AHJ requires them. Install steel pipe with threaded joints and fittings for 2 inch and smaller, and with welded joints for 2-1/2 inch and larger. Route vent to the outdoors thru building side wall and turn down or thru the roof and turn down minimum 18" above the roof or grade. Provide with line size (same size as gas relief) insect screen or gas relief vent. Provide vent sizes per the following developed length and include 3 feet of length for each elbow:
 - a. 10 feet developed length = size vent one pipe size larger than relief vent outlet size
 - b. 20 feet developed length = size vent two pipe size larger than relief vent outlet size
 - c. 30 feet developed length = size vent three pipe size larger than relief vent outlet size
 - d. 40 feet developed length = size vent four pipe size larger than relief vent outlet size

3.10 TERMINAL EQUIPMENT CONNECTIONS

- A. Install line size gas cock upstream and within 6 feet of gas appliance. Install a line size union or flanged connection downstream from the gas cock to permit removal of controls. Install reducer at the gas appliance connection, if required.
- B. Install stainless steel flexible gas pipe connector, of size and length as required to complete equipment hook-up of foodservice equipment. Verify appropriate length of flexible gas pipe connector for movement of the foodservice equipment for cleaning.

3.11 ELECTRICAL BONDING AND GROUNDING

- A. Install above ground portions of gas piping systems, upstream from equipment shutoff valves electrically continuous and bonded to a grounding electrode in accordance with NFPA 70 - "National Electrical Code."
- B. Do not use gas piping as a grounding electrode.
- C. Conform to NFPA 70 - "National Electrical Code," for electrical connections between wiring and electrically operated control devices.

3.12 FIELD QUALITY CONTROL

- A. Piping Tests: Inspect, test, and purge natural gas systems in accordance with NFPA 54, and local utility requirements.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

END OF SECTION

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SECTION 230010

GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL REQUIREMENTS

1.1 DESCRIPTION OF WORK

- A. This Division requires the furnishing and installing of complete functioning systems, and each element thereof, as specified or indicated on the Drawings and Specifications or reasonably inferred; including every article, device or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the work include materials, labor, supervision, supplies, equipment, transportation, and utilities.
- B. Division 23 of the Specifications and Drawings numbered with prefixes M, MP or ME, or MEP generally describe these systems, but the scope of the Mechanical work includes all such work indicated in the Contract Documents: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. The Drawings have been prepared diagrammatically intended to convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, ductwork, piping, etc. without showing all the exact details as to elevations, offsets, control lines, and other installation requirements. The Contractor shall use the Drawings as a guide when laying out the work and shall verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers requirements, will ensure a complete, coordinated, satisfactory and properly operating system.

1.2 QUALITY ASSURANCE

- A. All work under this Division shall be executed in a thorough professional manner by competent and experienced workmen licensed to perform the Work specified.
- B. All work shall be installed in strict conformance with manufacturers' requirements, recommendations, and installation instructions. Equipment and materials shall be installed in a neat and professional manner and shall be aligned, leveled, and adjusted for satisfactory operation.
- C. Material and equipment shall be new, shall be of the best quality and design, shall be current model of the manufacturer, shall be free from defects and imperfections and shall have markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Material and equipment of the same type shall be made by the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this project.

1.3 CODES, REFERENCES AND STANDARDS

- A. Execute Work in accordance with the National Fire Protection Association and all Local, State, and National codes, ordinances and regulations in force governing the particular class of Work involved. Obtain timely inspections by the constituted authorities, and upon final completion of the Work obtain and deliver to the Owner executed final certificates of acceptance from the Authority Having Jurisdiction.
- B. Any conflict between these Specifications and accompanying Drawings and the applicable Local, State and Federal codes, ordinances and regulations shall be reported to the Architect in sufficient time, prior to the opening of Bids, to prepare the Supplementary Drawings and Specification Addenda required to resolve the conflict.

- C. The governing codes are minimum requirements. Where these Drawings and Specifications exceed the code requirements, these Drawings and Specification shall prevail.
- D. All material, manufacturing methods, handling, dimensions, method or installation and test procedure shall conform to but not be limited to the following industry standards and codes:

BOCA	Building Officials Code Administration
IBC	International Building Code
IMC	International Mechanical Code
IPC	International Plumbing Code
IECC	International Energy Conservation Code
IFC	International Fire Code
IFGC	International Fuel Gas Code
ADA	American Disabilities Act
ADC	Air Diffusion Council
AMCA	Air Movement and Control Association, Inc.
ANSI	American National Standards Institute
AHRI	Air Conditioning, Heating and Refrigeration Institute
ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society of Testing Materials
AWS	American Welding Society
AWWA	American Water Works Association
CISPI	Cast Iron Soil Pipe Institute
ETL	Electrical Testing Laboratories
HI	Hydraulic Institute
MSS	Manufacturer's Standardization Society of the Valve and Fitting Industry
NBFU	National Board of Fire Underwriters
NEC	National Electrical Code
NFPA	National Fire Protection Association
NEMA	National Electrical Manufactures' Association
OSHA	Occupational Safety and Health Act
PDI	Plumbing and Drainage Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association, Inc.
UL	Underwriter's Laboratories

- E. Contractor shall comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. All mechanical work shall be performed in compliance with applicable safety regulations, including OSHA regulations. Safety lights, guards, shoring and warning signs required for the performance of the mechanical work shall be provided by the Contractor.

1.4 DEFINITIONS

A. General:

1. Furnish: The term "furnish" is used to mean "supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations."
2. Install: The term "install" is used to describe operations at the project site including the actual "unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations."
3. Provide: The term "provide" means "to furnish and install, complete and ready for the intended use."

4. **Furnished by Owner or Furnished by Others:** The item will be furnished by the Owner or Others. It is to be installed and connected under the requirements of this Division, complete and ready for operation, including items incidental to the Work, including services necessary for proper installation and operation. The installation shall be included under the guarantee required by this Division.
 5. **Engineer:** Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division, and is a Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
 6. **AHJ:** The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
 7. **NRTL:** Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other listed Manufacturers and models that meet the specified criteria.
 8. **Substitution:** Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. **Substitutions for Cause:** Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. **Substitutions for Convenience:** Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
 9. **Value Engineering:** A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. The following definitions apply to excavation operations:
1. **Additional Excavation:** Where excavation has reached required subgrade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. **Bedding:** Bedding as used in this section refers to the compacted sand or pea gravel installed in the bottom of a trench to immediately support and cover a pipe or duct.
 3. **Subbase:** as used in this Section refers to the compacted soil layer used in pavement systems between the subgrade and the pavement base course material.
 4. **Subgrade:** as used in this Section refers to the compacted soil immediately below the slab or pavement system.
 5. **Unauthorized excavation** consists of removal of materials beyond indicated subgrade elevations or dimensions without specific direction from the Architect.
 6. **Building Fill:** Building fill as used in this section refers to borrowed fill material of rock 1" and larger used to fill foundation excavations

1.5 COORDINATION

- A. The Contractor shall visit the site and ascertain the conditions to be encountered while installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work, and make due provision for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, incorrect or faulty installation of Work under this Division or for additional compensation for Work covered by this Division.
- B. The Contractor shall refer to Drawings of the other disciplines and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. The Contractor shall make offsets required to clear equipment, beams and other structural members; and to facilitate concealing piping and ductwork in the manner anticipated in the design.
- C. The Contractor shall confirm and coordinate the final location and routing of all mechanical, electrical, plumbing, fire protection, control and audio-visual systems with all architectural features, structural components, and other trades. The contractor shall locate equipment, components, ductwork, piping, conduit, and related accessories to maintain the desired ceiling heights as indicated on the architectural drawings. The contractor shall inform the architect of any areas where conflicts may prevent the indicated ceiling height from being maintained. The contractor shall not proceed with any installation in such areas until the architect has given written approval to proceed or has provided modified contract drawings or written instructions to resolve the apparent conflict.
- D. The Contractor shall provide materials with trim which will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. The Contractor shall maintain a foreman on the jobsite at all times to coordinate his work with other contractors and subcontractors so that various components of the mechanical systems will be installed at the proper time, will fit the available space, and will allow proper service access to the equipment. Carry on the Work in such a manner that the Work of the other contractors and trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as established by the Prime Contractor and his subcontractors and as approved by the Architect. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the building. Figured dimensions shall be taken in preference to scale dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing the Contract Documents. The Contractor will be held responsible for errors which could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements in addition to requirements specified herein.
- B. Submittals and shop drawings shall not contain the firm name, logo, seal, or signature of the Engineer. They shall not be copies of the work product of the Engineer. If the Contractor desires to use elements of such product, the license agreement for transfer of information obtained from the Engineer must be used.
- C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division as noted in each individual Section. Provide the number of submittals required by Division 01; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog

data not specifically noted to be part of the specified product will be rejected and returned without review.

- D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- F. Refer to individual Sections for additional submittal requirements.
- G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Architect, plus a duplication of this time for resubmittal if required. Transmit submittals as soon as possible after Notice to Proceed and before Mechanical construction starts.
- H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- I. Submittals shall contain the following information:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. Equipment identification acronym as used on the drawings.
 - 4. The submittal date.
 - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 - 6. Submittals not so identified will be returned to the Contractor without action.
- J. Refer to Division 01 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 01. Contractor shall notify the Architect and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- K. The checking and subsequent acceptance by the Engineer and/or Architect of submittals shall not relieve responsibility from the Contractor for (1) deviations from Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Architect prior to implementing any deviation.

1.8 SUBSTITUTIONS

- A. Refer to Division 01 and General Conditions for Substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.

- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
 - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.
 - c. Proposed substitution has received necessary approvals of authorities having jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
 - 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 - 2. No substitutions will be considered prior to receipt of Bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of Bids.
 - 3. If the proposed substitution is approved prior to receipt of Bids, such approval will be stated in an Addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.9 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 01 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.
- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Architect, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain data listed in each individual Section.
- F. Refer to Division 01 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures

specified in Division 01. Contractor shall notify the Architect and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 01, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Architect and Engineer's designated representative.

1.10 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections in Division 23 of this specification.

1.11 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Architect/Engineer.

1.12 TRAINING

- A. Provide training as indicated in each specific section. Schedule training with the Owner at least 7 days in advance. Video record the training sessions in format as agreed to with the Owner. Provide three copies of each session to the Owner and obtain written receipt from the Owner.

1.13 PAINTING

- A. Factory finishes, shop priming and special finishes are specified in the individual equipment specification sections.
- B. Where factory finishes are provided and no additional field painting is specified, marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Equipment and material shall be delivered to the job site in their original containers with labels intact, fully identified with manufacturer's name, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, to include the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which become rusted or damaged shall be replaced or restored by the Contractor to a condition acceptable to the Architect.
- D. The Contractor shall be responsible for the safe storage of his own tools, material and equipment.

1.15 GUARANTEES AND WARRANTIES

- A. Refer to Division 01 and General Conditions for Guarantees and Warranties in addition to requirements specified herein.

- B. Each system and element thereof shall be warranted against defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in the Construction Documents or manufacturer's standard warranty. The Contractor shall remedy defects occurring within a period of one year from the date of Substantial Completion or as stated in the General Conditions.
- C. The following additional items shall be guaranteed:
 - 1. Piping shall be free from obstructions, holes or breaks of any nature.
 - 2. Insulation shall be effective.
 - 3. Proper circulation of fluid in each piping system.
- D. The above guarantees shall include both labor and material; and repairs or replacements shall be made without additional cost to the Owner.
- E. The remedial work shall be performed promptly, upon written notice from the Architect or Owner.
- F. At the time of Substantial Completion, deliver to the Owner warranties with terms extending beyond the one year guarantee period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.16 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, water, sewerage, surface drainage and gas. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
 - 1. Provide the necessary backflow prevention devices where connecting to the potable water system. Protect water service from freezing by draining system or by providing adequate heat. Where non-potable water is used, mark each outlet with health hazard warning signs.
 - 2. Sewer Sediment: Maintain sewers and temporary connecting sewers in a clean, non-clogged condition during construction period.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
 - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
 - 2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees Fahrenheit. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.17 PROJECT CONDITIONS

- A. Conditions Affecting Work In Existing Buildings:
 - 1. The Drawings describe the general nature of remodeling to the existing building. However, the Contractor shall visit the Site prior to submitting his bid to determine the nature and extent of work involved.
 - 2. Work in the existing building shall be scheduled with the Owner.

3. Certain demolition work must be performed prior to the remodeling. The Mechanical Contractor shall perform the demolition which involves Mechanical systems, equipment, piping, equipment supports or foundations and materials.
 4. Mechanical Contractor shall remove articles which are not required for the new Work. Unless otherwise indicated, each item removed by the Mechanical Contractor during this demolition shall become his property and shall be removed by the Mechanical Contractor from the premises and dispose of them in accordance with applicable federal, state and local regulations.
 5. Mechanical Contractor shall relocate and reconnect Mechanical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where Mechanical equipment or materials are removed, the Mechanical Contractor shall cap unused piping beyond the floor line or wall line to facilitate restoration of finish.
 6. General Contractor shall install finish material.
 7. Obtain permission from the Architect for channeling of floors or walls not specifically noted on the Drawings.
 8. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services which transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Site Information: Subsurface conditions were investigated during the design of the Project. Reports of these investigations are available for information only; data in the reports are not intended as representations or warranties of accuracy or continuity of conditions. The Owner will not be responsible for interpretations or conclusions drawn from this information.
- D. Use of explosives is not permitted.
- E. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 NOT USED

2.2 SOIL MATERIALS

- A. Bedding Material: Provide clean sand, pea gravel or flowable fill material (per the geotechnical or structural engineer's recommendations).
- B. Subbase Material: Where applicable, provide natural soils with 10% by volume of rocks less than 2" diameter or artificially graded crushed aggregate. Corrosive fill materials shall be not be utilized. When CL clay, rock, or gravel is used, it shall not be larger than 2 inches in any dimension and shall be free of debris, waste, frozen materials, vegetable and other deleterious matter.
- C. Drainage Fill: Provide washed, evenly graded mixture of 3/4" open graded aggregate stone or gravel, around drainage pipes to a level above pipe as detailed by Architect. Provide open graded

aggregate, crushed stone, crushed or uncrushed gravel with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve for drainage fill to subgrade or around equipment structures.

- D. Filter Fabric: Flat needle punched PP or polyester fibers or combination of both, with flow rate range from 110 to 330 gpm/sq. ft. when tested according to ASTM D 4491.

PART 3 - EXECUTION

3.1 PERMITS

- A. Secure and pay for permits required in connection with the installation of the Mechanical Work. Arrange with the various utility companies for the installation and connection of required utilities for this facility and pay charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.2 EXISTING UTILITIES

- A. Schedule and coordinate with the Utility Company, Owner and with the Engineer connection to, or relocation of, or discontinuation of normal utility services from existing utility lines. Premium time required for any such work shall be included in the bid.
- B. Existing utilities damaged due to the operations of utility work for this project shall be repaired to the satisfaction of the Owner or Utility Company without additional cost.
- C. Utilities shall not be left disconnected at the end of a work day or over a weekend unless authorized by representatives of the Owner or Engineer.
- D. Repairs and restoration of utilities shall be made before workmen leave the project at the end of the workday in which the interruption takes place.
- E. Contractor shall include in his bid the cost of furnishing temporary facilities to provide services during interruption of normal utility service.

3.3 SELECTIVE DEMOLITION

- A. Refer to Division 02 and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.
- B. General: Demolish, remove, demount, and disconnect abandoned mechanical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment to Be Salvaged: Remove, demount, and disconnect existing mechanical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Mechanical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, and insulation.
 - a. Piping and ducts embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove exposed materials and materials above accessible ceilings. Drain and cap piping and ducts allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 23.
- F. Provide schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.

1. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

3.4 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02, and Division 31, Geotechnical Soils Report and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this Division. Excavation and Trenching shall be in conformance with applicable Division and section of the General Specifications.
- C. Roads, alleys, streets and sidewalks damaged during this work shall be restored to the satisfaction of Authorities Having Jurisdiction.
- D. Trenches close to walks or columns shall not be excavated without prior consultation with the Architect.
- E. Erect barricades around excavations and trenches for safety. Provide an adequate number of amber lights on or near the work and keep them burning from dusk to dawn. Contractor shall be held responsible for any damage that any parties may sustain due to neglecting the necessary precautions when performing the work.
- F. Slope sides of excavations and trenches to comply with Geotechnical Report, local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.
- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations and trenches regardless of time period excavations and trenches will be open.
 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering of Excavation and Trenches: Prevent surface water and subsurface or ground water from flowing into excavations and trenches.
 1. Do not allow water to accumulate in excavation or trenches. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations and trenches.
 2. Establish and maintain temporary drainage ditches and other diversions outside excavation and trench limits to convey surface water to collecting or run-off areas.
 3. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 1. Locate and retain soil materials away from edge of excavations and trenches. Do not store within drip-line of trees indicated to remain.
 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks, Basins, and Mechanical Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of 1 inch in diameter and larger with emulsified asphalt tree paint.
 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.

- L. Trenching: Excavate trenches as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6 to 9 inches clearance on both sides of pipe and equipment.
 - 2. Excavate trenches to depth indicated or required to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 - 3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
 - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of sand or pea gravel prior to installation of pipe. Provide a minimum of 6 inches of sand or pea gravel cushion between rock bearing surface and pipe.
 - 5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment bedding on undisturbed soil.
- M. Cold Weather Protection: Protect excavation and trench bottoms against freezing when atmospheric temperature is less than 35°F.
- N. Bedding:
 - 1. Fill bottom of pipe trench and fill unevenness with compacted bedding material to ensure continuous bearing of the pipe barrel on the bearing surface. Additional bedding installation requirements are in the following piping specifications. Compact bedding as described below.
 - 2. Fill bottom of equipment trench and fill unevenness with compacted sand backfill to ensure continuous bearing of the equipment on the bearing surface. Compact bedding as described below.
- O. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
 - 1. Under pipes, use bedding materials in layers to 6 inches above top of the pipe.
 - 2. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 - 3. Under building slabs, use subbase materials.
 - 4. Under piping and equipment, use bedding and subbase materials over rock bearing surface and for correction of unauthorized excavation.
 - 5. For piping less than 30 inches below surface of roadways, provide 4-inch-thick concrete protection slab. After installation and testing of pipes, provide a 4-inch thick concrete protection top slab prior to backfilling and placement of roadway subbase. Contractor shall coordinate with local AHJ as to requirements for colored concrete in this application.
 - 6. Other areas, use excavated or borrowed materials where applicable.
 - 7. Backfill excavations as promptly as work permits, but not until completion of the following:
 - a. Inspection, testing, approval, and locations of underground utilities have been recorded.
 - b. Removal of concrete formwork.
 - c. Removal of shoring and bracing, and backfilling of voids.
 - d. Removal of trash and debris.
 - 8. Where gravel fill (drainage fill) is used as building fill material in lieu of natural soils, provide filter fabric material to line the trench to support the bedding fill material and subgrade materials to ensure that backfill materials will not segregate within the trench nor create voids and sags within the pipe trench.
 - 9. Ductwork under slab shall be backfilled with a minimum of 4" bedding material on all sides for protection from soils (per Code). Subbase materials shall be utilized above the bedding material to the subgrade level.

- a. If concrete encasement is required, a minimum of 4" thickness all sides shall be provided unless otherwise noted. Contractor shall provide hold down straps as per manufacturer's recommendations.
 - b. If a concrete ballast pad is required, size of ballast pad shall be as noted on the drawings or as per manufacturer's recommendations.
- P. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- Q. Subgrade Placement and Compaction: Place subgrade backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
- R. 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 specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- S. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- T. Placement and Compaction: Place bedding backfill materials in maximum layers of not more than 6 inches loose depth for material compacted by hand-operated tampers. Place subbase backfill materials in maximum layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below.
1. Use of pneumatic backhoe as compaction method is disallowed as an acceptable process for compaction of excavations or trenches.
 2. For vertical and/or diagonal pipe installations greater than 1/2" rise/lf, thoroughly support pipes from permanent concrete structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that pipes are not deflected, crushed, broken, or otherwise damaged by the backfill placement or settlement.
 3. 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 specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
 4. Place backfill and/or drainage fill materials evenly adjacent to structures, piping, and equipment to required elevations. Coordinate with Architect and/or Civil Engineer backfill requirements prior to installation. Prevent displacement of pipes and equipment by carrying material uniformly around them to approximately same elevation in each layer or lift.
 5. Compaction: control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
 6. Percentage of maximum density requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 or ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

- a. Areas under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material listed, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 95 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of subbase backfill or fill material to 90 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
- U. Subsidence: Where subsidence occurs at mechanical installation excavations and trenches during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.5 CUTTING AND PATCHING

- A. Cut walls, floors, ceilings, and other portions of the facility as required to install work under this Division.
- B. Obtain permission from the Architect prior to cutting. Do not cut or disturb structural members without prior approval from the Architect and Structural Engineer.
- C. For post-tension slabs, x-ray slab and closely coordinate all core drill locations with Architect and Structural Engineer prior to performing any work. Obtain approval from Architect and Structural Engineer for all core drills and penetrations at least four days prior to performing work.
- D. Penetrations shall be made as small as possible while maintaining required clearances between the building element penetrated and the system component.
- E. Patch around openings to match adjacent construction, including fire ratings, if applicable.
- F. Repair and refinish areas disturbed by work to the condition of adjoining surfaces in a manner satisfactory to the Architect.

3.6 CLEANING

- A. Dirt and refuse resulting from the performance of the work shall be removed from the premises as required to prevent accumulation. The Mechanical Contractor shall cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to the final inspection, the Mechanical Contractor shall clean material and equipment installed under the Mechanical Contract. Dirt, dust, plaster, stains, and foreign matter shall be removed from surfaces including components internal to equipment. Damaged finishes shall be touched-up and restored to their original condition.

3.7 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting inspection for "CERTIFICATE OF SUBSTANTIAL COMPLETION", the Contractor shall complete the following items:
 - 1. Submit complete Operation and Maintenance Manuals.
 - 2. Submit complete Record Drawings.
 - 3. Perform special inspections as required in each individual Section.
 - 4. Start-up testing of systems.
 - 5. Removal of temporary facilities from the site.
 - 6. Comply with requirements for Substantial Completion in the "General Conditions".
- B. The Contractor shall request in writing a review for Substantial Completion. The Contractor shall give the Architect/Engineer at least seven (7) days notice prior to the review.
- C. The Contractor's written request shall state that the Contractor has complied with the requirements for Substantial Completion.

- D. Upon receipt of a request for review, the Architect/Engineer will either proceed with the review or advise the Contractor of unfulfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above mentioned items, He shall reimburse the Architect/Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Architect/Engineer will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, the Contractor shall submit a copy of the final list of items to be completed or corrected. He shall state in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
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Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
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Engineer Review and Recommendation Section

Recommend Acceptance Yes No
 Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

SECTION 230015

ELECTRICAL COORDINATION FOR MECHANICAL EQUIPMENT

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section specifies the basic requirements for electrical components which are an integral part of packaged mechanical equipment. These components include, but are not limited to factory furnished motors, starters, and disconnect switches furnished as an integral part of packaged mechanical equipment.
- B. Specific electrical requirements (i.e. horsepower and electrical characteristics) for mechanical equipment are scheduled on the Drawings.
- C. System shall be complete and operational with power and control wiring provided to meet the design intent shown on the drawings and specified within the specification sections.

1.2 SUBMITTALS

- A. No separate submittal is required. Submit product data for motors, starters, and other electrical components with submittal data required for the equipment for which it serves, as required by the individual equipment specification Sections.

1.3 QUALITY ASSURANCE

- A. Electrical components and materials shall be UL labeled.
- B. All electrical equipment provided and the wiring and installation of electrical equipment shall be in accordance with the requirements of this Section and Division 26.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. The Contractors shall provide all motors, starters, disconnects, wire, conduit, etc. as specified in the Construction Documents. If, however, the Division 23 Contractor furnishes a piece of equipment requiring a different motor, starter, disconnect, wire size, etc. than what is shown and/or intended on the Construction Documents, this Contractor shall coordinate the requirements with any other Contractor and shall be responsible for any additional cost incurred by any other Contractor that is associated with installing the different equipment and related accessories for proper working condition.
- B. Refer to Division 26, "COMMON WORK RESULTS FOR ELECTRICAL" for specification of motor connections.
- C. Refer to Division 26, "ENCLOSED CONTROLLERS" for specification of motor starters.
- D. Refer to Division 26, "ENCLOSED SWITCHES AND CIRCUIT BREAKERS" for specification of disconnect switches and enclosed circuit breakers.

PART 3 - EXECUTION

3.1 CONTRACTOR COORDINATION

- A. Unless otherwise indicated, all motors, equipment, controls, etc. shall be furnished, set in place and wired in accordance with Table 1. Any items not listed but shown on the drawings shall be considered part of the Contract Documents and brought to the attention of the Architect.
- B. The General Contractor is the central authority governing the total responsibility of all trade contractors. Therefore, deviations and clarifications of this schedule are permitted provided the General Contractor assumes responsibility to coordinate the trade contractors different than as indicated herein. If deviations or clarifications to this schedule are implemented, submit a record copy to the Engineer.

TABLE 1: ELECTRICAL REQUIREMENTS FOR MECHANICAL EQUIPMENT

ITEM	FURN BY	SET BY	POWER WIRING	CONTROL WIRING
Equipment motors	DIV23m	DIV23m	DIV26	---
Motor control centers	DIV26	DIV26	DIV26	DIV23t
Factory furnished motor starters contactors and disconnects	DIV23m	DIV23m	DIV26	DIV23t
Overload heaters	DIV23m	DIV26	---	---
Loose motor starters, disconnect switches, thermal overloads and heaters.	DIV26	DIV26	DIV26	DIV23t
Variable speed drives	DIV23m	DIV23m	DIV26	DIV23t
Manual operating multi-speed switches	DIV23m	DIV26	DIV26	DIV23t
Control relays	DIV23t	DIV23t	DIV26	DIV23t
Thermostats (low voltage)	DIV23t	DIV23t	---	DIV23t
Thermostats (line voltage)	DIV23m	DIV23m	DIV26	---
Time switches (for mechanical equipment)	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers	DIV23t	DIV23t	DIV26	DIV23t
Control power transformers furnished with equipment	DIV23m	DIV23m	DIV26	DIV23t
Temperature control panels (housing controllers)	DIV23t	DIV23t	DIV26	DIV23t
Building controllers, advanced application controllers, and application specific controllers	DIV23t	DIV23t	DIV23t	DIV23t
Motor and solenoid operated valves	DIV23t	DIV23m	DIV23t	DIV23t
Presssure independent control valves	DIV23t	DIV23m	DIV23t	DIV23t
Damper operators, PE & switches	DIV23t	DIV23t	DIV23t	DIV23t
Smoke dampers and combination fire/smoke dampers	DIV23m	DIV23m	DIV26	DIV28
Smoke dampers for smoke control system	DIV23t	DIV23m	DIV26	DIV23t/28
Duct Smoke detectors	DIV28	DIV23m	DIV28	DIV28
Pushbutton stations and connections	DIV23m	DIV23m	DIV26	DIV23t
Temporary heating connections	DIV23m	DIV23m	DIV26	DIV23m

DIV23m = Mechanical Contractor

DIV23t = Temperature Controls Sub-Contractor

DIV26 = Electrical Contractor

DIV28 = Electronic Safety and Security

END OF SECTION

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes limited scope general construction materials and methods for application with mechanical installations as follows:
1. Access panels and doors in walls, ceilings, and floors for access to mechanical materials and equipment.
 2. Mechanical equipment nameplate data.
 3. Concrete for bases and housekeeping pads.
 4. Non-shrink grout for equipment installations.
 5. Sleeves for mechanical penetrations.
 6. Miscellaneous metals for support of mechanical materials and equipment.
 7. Wood grounds, nailers, blocking, fasteners, and anchorage for support of mechanical materials and equipment.
 8. Joint sealers for sealing around mechanical materials and equipment.
- B. Related Sections: The following sections contain requirements that relate to this Section:
1. Division 26 Section "Common Work Results for Electrical" required electrical devices.
 2. Division 26 Sections "Enclosed Switches and Circuit Breakers" for field-installed disconnects.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 23 Section General Mechanical Requirements.
1. Product data for the following products:
 - a. Access panels and doors.
 - b. Joint sealers.
 - c. Through and membrane-penetration firestopping systems.
 2. Shop drawings detailing fabrication and installation for metal fabrications, and wood supports and anchorage for mechanical materials and equipment.
 3. Welder certificates, signed by Contractor, certifying that welders comply with requirements specified under "Quality Assurance" article of this Section.
 4. Schedules indicating proposed methods and sequence of operations for selective demolition prior to commencement of Work. Include coordination for shut-off of utility services and details for dust and noise control.
 - a. Coordinate sequencing with construction phasing and Owner occupancy specified in Division 01 Section "Summary of Work."

5. Through and Membrane Penetration Firestopping Systems Product Schedule: Submit a schedule for each piping system penetration that includes UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.

1.3 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
- B. Fire-Resistance Ratings: Where a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating shown.
 1. Provide UL Label on each fire-rated access door.
- C. Through and Membrane Penetration Firestopping Systems Installer Qualifications: A firm experienced in installing penetration firestopping systems similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer's products per specified requirements. Manufacturer's willingness to sell its penetration firestopping system products to Contractor or to Installer engaged by Contractor does not in itself confer qualification on buyer.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCESS TO EQUIPMENT

- A. Manufacturers:
 1. Bar-Co., Inc.
 2. Elmdor Stoneman.
 3. JL Industries
 4. Jay R. Smith Mfg. Co.
 5. Karp Associates, Inc.
 6. Milcor
 7. Nystrom Building Products
 8. Wade
 9. Zurn
- B. Access Doors:
 1. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.

2. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
3. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 - a. Fire-Rated Units: Insulated flush panel doors, with continuous piano hinge and self-closing mechanism.
4. Locking Devices: Flush, screwdriver-operated cam locks.
5. Locking Devices: Where indicated on the drawings or where access panels are installed in locations accessible to the public, provide 5-pin or 5-disc type cylinder locks, individually keyed; provide 2 keys.

2.2 MECHANICAL EQUIPMENT NAMEPLATE DATA

- A. For each piece of power operated mechanical equipment, provide a permanent operational data nameplate indicating manufacturer, product name, model number, serial number, capacity, operating and power characteristics, labels of tested compliance's, and similar essential data. Locate nameplates in an accessible location.

2.3 CONCRETE EQUIPMENT BASES/HOUSEKEEPING PADS

- A. Provide concrete equipment bases and housekeeping pads for various pieces of floor mounted mechanical equipment. Concrete equipment bases/housekeeping pads shall generally conform to the shape of the piece of equipment it serves with a minimum 4" margin around the equipment and supports.
- B. Form concrete equipment bases and housekeeping pads using framing lumber or steel channel with form release agent. Chamfer top edges and corners. Trowel tops and sides of each base/pad to a smooth finish, equal to that of the floors.
- C. Concrete equipment bases and housekeeping pads shall be made of a minimum 28 day, 4000 psi concrete conforming to American Concrete Institute Standard Building Code for Reinforced Concrete (ACI 318-99) and the latest applicable recommendations of the ACI standard practice manual. Concrete shall be composed of cement conforming to ASTM C 150 Type I, aggregate conforming to ASTM C33, and potable water. All exposed exterior concrete shall contain 5 to 7 percent air entrainment.
- D. Unless otherwise specified or shown on the structural drawings, reinforce equipment bases and housekeeping pads with No. 4 reinforcing bars conforming to ASTM A 615 or 6x6 – W2.9 x W2.9 welded wire mesh conforming to ASTM A185. Reinforcing bars shall be placed 24" on center with a minimum of two bars each direction.
- E. Provide galvanized anchor bolts for all equipment placed on concrete equipment bases and housekeeping pads or on concrete slabs. Anchor bolts size, number and placement shall be as recommended by the Manufacturer of the equipment.
- F. Concrete equipment bases and housekeeping pads shall have height as specified on the drawings or minimum height if not specified in accordance with the following table:

Equipment	Minimum Height
Furnaces, Exterior Equipment Less than or equal to 20 tons and Other Equipment Not Listed	3-1/2"
Air Handling Units w/TSP less than or equal to 3.5", Boilers (See Note 1)	3-1/2"
Chillers, Condensate Pumps, Base Mounted Pumps up to 30 HP, Air Handling Units w/TSP greater than 3.5", All Vertical Inline Pumps, (See Note 1)	5-1/2"

NOTES:

1. Height of equipment bases applies to equipment installed on slab-on-grade. For equipment installed on floors above grade and/or roof, reference the drawings.
2. Coordinate final pad heights for air handling units with required condensate trap depths. Increase pad heights as needed to allow for unit trap height and required slope to drain.

2.4 GROUT

- A. Provide nonshrink, nonmetallic grout conforming to ASTM C 1107, Grade B, in premixed and factory-packaged containers.
- B. Grout shall have post-hardening, volume-adjusting, dry, non-staining, non-corrosive, non-gaseous, hydraulic-cement characteristics and shall be as recommended by manufacturer for interior and exterior applications.
- C. Grout shall have 5,000 psi, 28-day compressive strength design mix.

2.5 PENETRATIONS

- A. Sleeves:
 1. Steel Sleeves: Schedule 40 galvanized, welded steel pipe, ASTM A-53 grade A or 12 gauge (0.1084 inches) welded galvanized steel formed to a true circle concentric to the pipe.
 2. Sheet-Metal Sleeves: 10 gauge (0.1382 inches), galvanized steel, round tube closed with welded longitudinal joint.
- B. Frames for rectangular openings attached to forms and of a maximum dimension established by the Architect. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, provide 18 gauge (0.052 inches) welded galvanized steel. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, provide 10 gauge (0.1382 inches) welded galvanized steel. Notify the General Contractor or Architect before installing any box openings not shown on the Architectural or Structural Drawings.

2.6 MISCELLANEOUS METALS

- A. Steel plates, shapes, bars, and bar grating: ASTM A 36.
- B. Cold-Formed Steel Tubing: ASTM A 500.
- C. Hot-Rolled Steel Tubing: ASTM A 501.
- D. Steel Pipe: ASTM A 53, Schedule 40, welded.
- E. Fasteners: Zinc-coated, type, grade, and class as required.

2.7 MISCELLANEOUS LUMBER

- A. Framing Materials: Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards

complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent.

- B. Construction Panels: Plywood panels; APA C-D PLUGGED INT, with exterior glue; thickness as indicated, or if not indicated, not less than 15/32 inches.

2.8 JOINT SEALERS

- A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
- B. Colors: As selected by the Architect from manufacturer's standard colors.
- C. Nonacid Curing Sealer: One-part, nonacid-curing, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - 1. Manufacturers:
 - a. Dow Corning, Dowsil 790.
 - b. Dow Corning, Dowsil 795.
 - c. GE, Silglaze II SCS 2350.
 - d. GE, Silpruf SCS 2000.
 - e. Owens Corning, Energy Complete.
 - f. Pecora, 864 NST.
 - g. Tremco, Spectrem 1.
 - h. Tremco, Spectrem 2.
- D. High Humidity Sealer: One-part, mildew-resistant, silicone sealant complying with ASTM C920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - 1. Manufacturers:
 - a. Dow Corning, Dowsil 786.
 - b. GE, Momentum SCS1700.
 - c. Pecora, 898 Silicone NST.
- E. Hybrid Joint Sealer: One-part, non-sag, paintable complying with ASTM C920, Type S, Grade NS, Class 50, recommended for exposed applications on interior and exterior locations involving joint movement of not more than plus or minus 50 percent.
 - 1. Manufacturers:
 - a. BASF, MasterSeal NP 100.
 - b. Pecora, DyanTrol I-XL.
 - c. Tremco, Dymonic FC.
- F. Acrylic Latex Joint Sealer: One-part, non-sag, mildew-resistant, paintable acrylic latex or siliconized acrylic latex, complying with ASTM C834, Type OP, Grade NF, recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Manufacturers:
 - a. Pecora, AC-20
 - b. Sherwin Williams 950A
 - c. Tremco, Tremflex 834

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.

3.2 INSTALLATION OF ACCESS DOORS

- A. Provide access doors for all concealed equipment and duct and piping accessories that require service where indicated or as required, except where above lay-in ceilings. Refer to Section "Identification for HVAC Piping and Equipment" for labeling of access doors.
- B. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
- C. Access doors must be of the proper construction for type of construction where installed.
- D. The exact location of all access doors shall be verified with the Architect prior to installation.
- E. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- F. Adjust hardware and panels after installation for proper operation.

3.3 ERECTION OF METAL SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Field Welding: Comply with AWS "Structural Welding Code."

3.4 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not 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 members.
- C. Attach to substrates as required to support applied loads.

3.5 PREPARATION FOR JOINT SEALERS

- A. Surface Cleaning for Joint Sealers: Clean surfaces of joints immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
- B. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.

3.6 APPLICATION OF JOINT SEALERS

- A. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.

1. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 2. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
- B. Tooling: Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

3.7 PENETRATIONS:

- A. Construction in Existing Facilities:
1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Architect, Owner, or both. Seal sleeves and sleeve seals into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Architect.
- B. Provide sleeves and/or box frames for openings in all concrete and masonry construction and fire or smoke partitions, for all mechanical work that passes through such construction; Coordinate with other trades and Divisions to dimension and lay out all such openings.
- C. All sleeves shall be of ample size to allow for movement of conduit, duct or pipe and insulation through the sleeves without damage to the insulation.
- D. Cut sleeves to length for mounting flush with both surfaces of walls.
- E. Extend sleeves installed in floors 2 inches above finished floor level.
- F. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
- G. Seal space outside of sleeves with approved joint compound for penetrations of gypsum board assemblies.

END OF SECTION

SECTION 230513

COMMON MOTOR REQUIREMENT FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General construction and requirements.
- B. Applications.
- C. Single phase electric motors.
- D. Three phase electric motors.
- E. Electronically Commutated Motors (ECM).
- F. Capacitors.

1.2 REFERENCE STANDARDS

- A. ABMA STD 9 – Load Ratings and Fatigue Life for Ball Bearings; most recent edition.
- B. IEEE 112 – IEEE Standard Test Procedure for Polyphase Induction Motors and Generators; most recent edition.
- C. NEMA MG 1 – Motors and Generators; most recent edition.
- D. NFPA 70 – National Electrical Code; most recent edition adopted by the Authority Having Jurisdiction, including all applicable amendments and supplements.

1.3 SUBMITTALS

- A. Conform with the submittal procedures in Division 01.
- B. Product Data: Provide wiring diagrams with electrical characteristics and connection requirements. Provide nameplate data and ratings, mounting arrangements, size and location of winding termination lugs, overload relays, conduit entry, grounding lug, and coatings.
- C. Test Reports: Indicate test results verifying nominal efficiency and power factor for three phase motors larger than 1/2 horsepower.
- D. Manufacturer's Installation Instructions: Indicate setting, mechanical connections, lubrication, and wiring instructions.
- E. Operation Data: Include instructions for safe operating procedures.
- F. Maintenance Data: Include assembly drawings, bearing data including replacement sizes, and lubrication instructions.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.5 DELIVERY STORAGE AND HANDLING

- A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6 WARRANTY

- A. Provide five year manufacturer warranty for motors larger than 20 horsepower.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. Baldor Electric Company.
- B. General Electric.
- C. Gould.
- D. Marathon.
- E. Regal-Beloit Corporation (Century).
- F. Westinghouse

2.2 GENERAL CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: All motors shall be supplied in accordance with the following voltage and phase unless noted otherwise on the Drawings.
 - 1. Motors 1/2 HP and Smaller: 115 volts, single phase, 60 Hz.
 - 2. Motors 3/4 HP and Larger: Voltage as scheduled, three phase, 60 Hz.
- B. Construction:
 - 1. Open drip-proof except where noted otherwise.
 - 2. Design for continuous operation in 104 degrees F environment.
 - 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 - 4. Motors with frame sizes 254T and larger: Energy Efficient Type.
- C. Explosion-Proof Motors: UL approved and labeled for hazard classification, with over temperature protection.
- D. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- E. Wiring Terminations:
 - 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 - 2. For fractional horsepower motors where connection is made directly, provide flexible conduit connection in end frame. Maximum length of flexible conduit shall be five feet.

2.3 APPLICATIONS

- A. Exception: Motors less than 250 Watts, for intermittent service may be the equipment manufacturer's standard and need not comply with these specifications.
- B. Single phase motors for shaft mounted fans or blowers: Permanent split capacitor type.
- C. Single phase motors for fans, pumps, blowers and air compressors: Capacitor start type.
- D. Single phase motors for fans less than 1 hp and greater than 1/12 hp: Electronically commutated type.
- E. Motors located in exterior locations, air cooled condensers, humidifiers and explosion proof environments: Totally enclosed fan cooled type.
- F. Motors located outdoors in wet airstreams, including but not limited to cooling towers, evaporative condensers, and sprayed coils: Totally enclosed weatherproof epoxy-sealed type.

2.4 SINGLE PHASE POWER - PERMANENT-SPLIT CAPACITOR MOTORS

- A. Starting Torque: Exceeding one fourth of full load torque.
- B. Starting Current: Up to six times full load current.
- C. Multiple Speed: Through tapped windings.

- D. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.

2.5 SINGLE PHASE POWER - CAPACITOR START MOTORS

- A. Starting Torque: Three times full load torque.
- B. Starting Current: Less than five times full load current.
- C. Pull-up Torque: Up to 350 percent of full load torque.
- D. Breakdown Torque: Approximately 250 percent of full load torque.
- E. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
- F. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated ball bearings.
- G. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.

2.6 THREE PHASE POWER - SQUIRREL CAGE MOTORS

- A. Starting Torque: Between 1 and 1-1/2 times full load torque.
- B. Starting Current: Six times full load current.
- C. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
- D. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
- E. Insulation System: NEMA Class B or better.
- F. Drip-proof Enclosure: NEMA Service Factor.
- G. All motors controlled by variable frequency controllers shall have a 1.15 Service Factor.
- H. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
- I. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
- J. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter; refer to Division 26 - Motor Controlling Equipment.
- K. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum AFBMA 9, L-10 life of 20,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
- L. Sound Power Levels: To NEMA MG 1.
- M. All totally enclosed motors shall be fan cooled type. Non-ventilated type motors are not acceptable.
- N. Motors controlled by variable frequency drives:
 - 1. Rated for voltage peaks and minimum rise times in accordance with NEMA MG1, Part 31.
 - 2. 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.
 - 3. Inverter-Duty Motors: Class B temperature rise; Class F insulation.
 - 4. Grounding: Provide shaft grounding system equal to AEGIS SGR Bearing Protection Ring, Inpro/Seal Current Diverter Ring (CDR) or approved equal. Install system in accordance with manufacturer's recommendations.

- 5. Motor Overload Relay: When a single drive is used to supply power to multiple motors, provide a solid state 3-phase adjustable overload relay between the drive and each motor.
 - a. Relay shall have manual reset.
 - b. Provide alarm contact with automatic reset overloads.
 - O. Part Winding Start, Where Indicated: Use part of winding to reduce locked rotor starting current to approximately 60 percent of full winding locked rotor current while providing approximately 50 percent of full winding locked rotor torque.
 - P. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
 - Q. Nominal Efficiency: Motors shall have minimum NEMA premium efficiency at full load and rated voltage when tested in accordance with IEEE 112.
 - R. Nominal Power Factor: As scheduled at full load and rated voltage when tested in accordance with IEEE 112.
- 2.7 ELECTRONICALLY COMMUTATED MOTORS (ECM)
- A. Minimum efficiency: 70 percent when rated in accordance with NEMA Standard MG 1 at full load rating conditions.
 - B. Motor shall be permanently lubricated with heavy-duty ball bearings to match the equipment load and prewired to the specific voltage and phase.
 - C. Internal motor circuitry shall convert AC power supplied to the equipment to DC power to operate the motor.
 - D. Motor shall be speed controllable down to 20% of full speed (80% turndown). Speed shall be controlled by either a potentiometer dial mounted on the motor or by a 0-10 VDC signal.
- 2.8 CAPACITORS
- A. Furnish capacitors for power factor correction as specified herein on motors furnished under Division 23 that are not connected to variable frequency drives. KVAR size shall be as required to correct motor power factor to 90 percent or better and shall be installed on all motors 1 horsepower and larger, that have an uncorrected power factor of less than 85 percent at rated load.
 - B. Features:
 - 1. Individual unit cells.
 - 2. All welded steel housing.
 - 3. Each capacitor internally fused.
 - 4. Non-flammable synthetic liquid impregnated.
 - 5. Craft tissue insulation.
 - 6. Aluminum foil electrodes.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install securely on firm foundation.
- C. Check line voltage and phase and ensure agreement with nameplate.
- D. Install motor overload relays in a common enclosure adjacent to the variable frequency drive

3.2 NEMA OPEN MOTOR SERVICE FACTOR SCHEDULE

HP	3600 RPM	1800 RPM	1200 RPM	900 RPM
1/6-1/3	1.35	1.35	1.35	1.35
1/2	1.25	1.25	1.25	1.15
3/4	1.25	1.25	1.15	1.15
1	1.25	1.15	1.15	1.15
1.5-150	1.15	1.15	1.15	1.15

3.3 PERFORMANCE SCHEDULE: THREE PHASE - OPEN DRIP-PROOF

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	84	73
2	1200	184T	85.5	75
3	1200	213T	86.5	60
5	1200	215T	87.5	65
7-1/2	1200	254T	88.5	73
10	1200	256T	90.2	74
15	1200	284T	90.2	77
20	1200	286T	91	78
25	1200	324T	91.7	74
30	1200	326T	92.4	78
40	1200	364T	93	77
50	1200	365T	93	79
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	86.5	86
5	1800	184T	87.5	87
7-1/2	1800	213T	88.5	86
10	1800	215T	89.5	85
15	1800	256T	91	85
20	1800	256T	91	86
25	1800	284T	91.7	85
30	1800	286T	92.4	88
40	1800	324T	93	83

3.4 PERFORMANCE SCHEDULE: THREE PHASE-ENERGY EFFICIENT, TOTALLY ENCLOSED, FAN COOLED

HP	RPM(Sync)	NEMA Frame	Minimum Percent Efficiency	Minimum Power Factor
1	1200	145T	80	72
1-1/2	1200	182T	85.5	65
2	1200	184T	86.5	68
3	1200	213T	87.5	63
5	1200	215T	87.5	66
7-1/2	1200	254T	89.5	68
10	1200	256T	89.5	75
15	1200	284T	90.2	72
20	1200	286T	90.2	76
25	1200	324T	91.7	71
30	1200	326T	91.7	79
40	1200	364T	93	78
1	1800	143T	82.5	84
1-1/2	1800	145T	84	85
2	1800	145T	84	85
3	1800	182T	87.5	83
5	1800	184T	87.5	83
7-1/2	1800	213T	89.5	85
10	1800	215T	89.5	84
15	1800	254T	91	86
20	1800	256T	91	85
25	1800	284T	92.4	84
30	1800	286T	92.4	86
40	1800	324T	93	83

END OF SECTION

SECTION 230514

VARIABLE FREQUENCY DRIVES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Variable speed drives shall be furnished for those units so indicated on the drawings. All variable speed drives provided under this section shall be by the same manufacturer.
- B. Type of variable speed drive specified in this Section include the following:
 - 1. Pulse Width Modulated

1.2 QUALITY ASSURANCE

- A. Testing: The variable speed drive, all components and subassemblies shall be factory tested. The variable speed drive shall be tested and cycled under motor load.
- B. Reliability: A complete description of supplier's Quality Assurance and Testing program shall be provided.
 - 1. Component Testing: All power semiconductors and integrated circuits shall be 100% tested.
 - 2. Computerized ATE Testing: Computerized Automated Testing Equipment (ATE) testing shall be used to evaluate functional performance of printed circuit boards. Printed circuit boards shall receive a thermal stress test where temperatures are cycled between 0°C and 65°C and receive electrical power-on and power-off cycle tests.
 - 3. Burn In: All VFD's shall be tested/run in the equivalent of a NEMA 1 or NEMA 3R (NEMA 1 if indoors and NEMA 3R if outdoors) enclosure and burned in at rated ambient (40°C) with a fully loaded motor.

1.3 CODES AND STANDARDS:

- A. The VFD shall meet the following standards.
 - 1. Institute of Electrical and Electronic Engineers (IEEE)
 - a. Standard 519-2014 IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems
 - 2. Nationally recognized testing lab such as UL or ETL
 - a. UL 508C (Variable frequency drive)
 - b. UL 508A (Bypass)
 - 3. NEMA – ICS 7.0, AC Adjustable Speed Drives

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
 - 1. Product Data: Submit manufacturer's technical product data for variable speed drive including dimensions, capacities, component performance data, ratings, features, motor electrical characteristics, over current protection rating, gages and finishes of material, and installation instructions.
 - 2. Shop Drawings: Submit assembly-type shop drawings including unit dimensions, required clearances, control description, construction details, and field connection details.
 - 3. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring to variable speed drives. 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.

4. Maintenance Data: Submit maintenance instructions, including instructions for adjustments, troubleshooting, operation, testing and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in maintenance manuals; in accordance with requirements of Division 1 and Division 23 Section "General Mechanical Requirements."
5. Harmonic Analysis Report: Provide project-specific calculations and manufacturer's statement of compliance with IEEE 519.

1.5 WARRANTY

- A. Provide warranty including on site parts and labor for minimum 36 months from date of shipment.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL:

- A. Provide factory assembled and factory tested variable speed drives as indicated, of sizes and capabilities as scheduled, and as specified herein.

2.2 MANUFACTURERS:

- A. Subject to compliance with requirements, manufacturers offering variable speed drives which may be incorporated in the work are limited to the following:
 1. ABB.
 2. Danfoss.
 3. Eaton/Cutler-Hammer.
 4. Franklin Control Systems.
 5. Invertek.
 6. Square D, a division of Schneider Electric.
 7. Yaskawa Electric America.

2.3 VARIABLE FREQUENCY DRIVES

- A. The VFD shall provide the following design features as standard:
 1. Input Section: Full wave rectification shall be achieved with input diodes in a conventional bridge configuration and shall be used to supply voltage to the DC bus. Drive shall be provided with dual DC bus chokes or AC line reactors, as required, for a total input impedance of 5% or better.
 2. Output Section: The inverter shall use power transistors to provide three phase output power to the motor.
 3. Input Displacement Power Factor: The input displacement power factor shall be 0.97 or higher at all operating speeds and loads.
 4. Microprocessor Logic: The VFD shall be microprocessor based and utilize digital input for all parameter adjustments. Use of potentiometers for parameter adjustment is not acceptable.
 5. Auto Restart: The VFD shall automatically attempt to restart after a malfunction or an interruption of power. The number of attempted restarts shall be customer selectable (0 to 5). If the drive reaches the limit of restarts without successfully restarting and running for a customer selectable length of time (60 to 600 seconds), the restart circuit shall lockout and shall provide contact annunciation. Delay between attempts to restart shall be customer selectable from 3 to 300 seconds.
 6. Current Limit: A current limit circuit shall be provided to limit motor current to a preset adjustable maximum level by reducing the drive operating speed or acceleration rate when the limit is reached. Range of adjustment shall be from 50 to 110%.
 7. Digital Output Displays and Input Parameter Programming: The VFD shall include a digital display and digital input programming capability on the main logic board. The display shall

- be programmable for indication of output speed in rpm, frequency, and percent of base speed, motor amps, output motor volts, and output load. The display shall also function as a first fault indicator.
8. Critical Frequency Avoidance (Frequency Jump Points): The VFD shall provide selectable frequency jump points to be used to avoid critical resonance frequencies of the mechanical system.
 9. Input Signal Follower: The input signal follower circuit shall have selectable differential inputs and accept an electrical speed command from an external source rated at 4-20 mA or 0-10Vdc. The input follower circuit shall be capable of operating directly or inversely proportional to the listed speed commands.
 10. Motor Overload Protection: Electronic motor protection shall be provided which is capable of predicting motor winding temperature based on inputting specific parameters including motor design type (TEFC, ODP, or other) and speed range. The protection shall provide an orderly shutdown should the motor's thermal capabilities be exceeded. This protection also eliminates the requirement for motor overload relays on single motor applications when a bypass is not used.
 11. Open Collector Outputs: The VFD shall include three (3) open collector outputs to indicate drive run, drive fault, and drive ready.
 12. Output Signals: The VFD shall include analog output signals for output load, output speed, instantaneous kw and motor voltage. The signals shall be 4-20 ma or 0-10 Vdc @ 1 mA.
 13. Stop Mode Functions: The VFD stopping mode functions shall be selectable for coast-to-rest or stopping at programmed deceleration rate.
 14. V/Hz Profiles: The VFD shall provide selectable V/Hz profiles.
 15. Loss of Control Signal: The VFD shall revert to the last speed on loss of input control signal. Owner shall be able to field select a preset speed for the VFD to run when control signal is lost, if preferred. In either case, an open collector output shall be selected to indicate loss of control signal for remote indication purposes.
- B. The VFD supplier shall provide the same design/technology to cover the HP range for all VFD's.
- C. Output Ratings: The VFD shall operate within the following ratings:
1. Frequency range: 1-120 Hz
 2. Overload rating: 110% for one minute
- D. Motor Performance: The VFD shall provide 3% speed regulation.
- E. Input Power: The VFD shall operate within (+5%/-10%) of the nominal rated voltage.
- F. Set-up Adjustments: Standard setup adjustments shall include:
1. Minimum speed: 0 to 100%
 2. Maximum speed: 0 to 100%
 3. Linear accel: 0.5 to 600 seconds
 4. Linear decel: 0.5 to 600 seconds
 5. Maximum output voltage: Adjustable
 6. V/Hz: Adjustable with selectable profiles
 7. Current limit: 50 to 110%
- G. Environmental Ratings: The VFD shall operate within the following parameters without the requirement for derating:
1. Operating temperature: 0°C to 40°C
 2. Altitude: Up to 1000m (3300 ft.)
 3. Humidity: 95% non-condensing

- H. Enclosure: Refer to VFD schedule or drawings for enclosure type. At minimum, the enclosure shall be suitable for environment installed. Finned heatsinks and/or cooling fans shall be provided as necessary for proper heat dissipation.
- I. Protective Features: The VFD shall be designed to meet the following specifications and operate within the following parameters:
 - 1. AC Input Overcurrent Protection: The VFD's power circuit shall be isolated internally with respect to ground and provided with a 100,000 AIC interrupting rated input circuit breaker. As an alternate to the circuit breaker, fuses may be used to accomplish the 100,000 A interrupting rating.
 - 2. Logic Common: The power unit's logic common shall be at ground potential.
 - 3. Phase Loss Protection: Phase loss protection shall be provided to prevent single phasing.
 - 4. Power Loss Ride-Through: The VFD shall be capable of continued operation during an intermittent loss of power. Opening of the VFD's input and/or output line switches while operating shall not result in damage to the power circuit components.
 - 5. Short Circuit and Ground Fault Protection: The VFD shall have an instantaneous electronic trip circuit to protect the VFD from output line-to-line and line-to-ground short circuits. The VFD must be capable of withstanding short circuits at nominal rated voltage plus 10%(i.e., 480V rated drive + 10% = 528V short circuit voltage). The VFD shall be capable of providing 110% motor current intermittently. The VFD shall include an instantaneous overcurrent trip and shall not restart after electronic overcurrent trip until reset through the run/stop circuit, or unless the auto restart function has been enabled.
 - 6. Transient and Surge Voltage Protection: Transient and surge voltage protection shall be provided through the use of Metal Oxide Varistors (MOVs). The VFD shall withstand a 6000 volt, 80 joule surge voltage when tested in accordance with UL 1449 with the test circuit adjusted for a 2100 amp peak 8x20 us short circuit discharge current pulse.
 - 7. Rotating Motor Start: The VFD shall be able to start into a motor rotating in either direction and at any speed, and accelerate to set speed without any time delay, tripping or component loss.
 - 8. DV/DT Filters: Dv/dt filters shall be provided per the VFD schedule, or if recommended by the VFD manufacturer to ensure that the VFD is applied correctly and to maintain the manufacturer's full warranty.
- J. Maintainability
 - 1. All control circuit voltages (12VAC, 24VDC, 160VDC and 120VAC) shall be physically and electrically isolated from power circuit voltages (200 to 600VAC, 600VDC) to ensure safety to maintenance personnel.
 - 2. The VFD shall be furnished with an alphanumeric diagnostic display with fault indications to include the following: bus overvoltage, bus undervoltage, overcurrent, overtemperature, ground fault, and timed overload.
 - 3. VFD shall be capable of starting and operating without a motor connected for ease of service.
 - 4. All setup and operating parameters shall be stored in nonvolatile memory. The static memory module shall be to be removed and installed in replacement logic boards with all setup and operating parameters intact requiring no adjustment of replacement boards.
- K. Communications
 - 1. The VFD shall have an RS-485 port as standard. The standard protocols shall be BACnet, Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN. Optional protocols for LonWorks, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the protocol in the base VFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority. Use of non-certified protocols is not allowed.

2. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, accel/decel time adjustments, and lock and unlock the keypad. The drive shall have the capability of allowing the building management system to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The building management system shall also be capable of monitoring the VFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote VFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad “Hand” or “Auto” selected, bypass selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The building management system shall also be able to monitor if the motor is running in the VFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.
 3. The VFD shall allow the building management system to control the drive’s digital and analog outputs via the serial interface. This control shall be independent of any VFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive’s digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive’s digital and analog inputs shall be capable of being monitored by the building management system.
 4. The VFD shall include an independent PID loop for customer use. The independent PID loop may be used for cooling tower bypass value control, chilled water value control, etc. Both the VFD control PID loop and the independent PID loop shall continue functioning even if the serial communications connection is lost. The VFD shall keep the last good set-point command and last good DO & AO commands in memory in the event the serial communications connection is lost.
- L. Required Optional Features
1. Operator Panel: A door-mounted Softouch Operator Panel shall be included with the following features:
 - a. Shall digitally display motor speed, load, amps, and output volts. (and controller setpoint and system pressure when setpoint controller is included).
 - b. Shall have indication for drive run, drive ready, drive fault, plus operator function/status indication such as auto speed reference, and auto restart.
 - c. Shall provide selection for Hand/Off/Auto control. In Hand mode, the VFD shall be started and stopped from the operator’s panel. In the Auto mode, the VFD shall be started and stopped by remote contact closure. In the Off mode, the VFD shall be locked out.
 - d. Shall provide selection for Manual/Auto Speed Reference. In the Manual Reference mode, the VFD speed reference shall be set from the operator’s panel. In the Auto Reference mode, the VFD speed reference shall be set by the external source instrument signal. Selecting between Manual and Auto speed reference shall have no bearing on the Hand/Off/Auto start/stop selector, or vice versa.
 - e. Shall name all parameters in English, not codes or numbers.
 - f. Keypad shall include electronic lock-out feature to prevent unauthorized personnel from parameter access.
 - g. Shall store from three to six drive faults in a history batch file in the order they occur to simplify trouble-shooting. This file will automatically be updated should new faults occur.

2. Input Overcurrent Protection Device: The operating mechanism shall be designed so that the door can be padlocked in the "OFF" position.
3. Elapsed Time Meter: Meter shall provide indication of how long the drive has been running.
4. Firestat/Freezestat: VFDs for air system fans requiring shutoff from safety devices per sequences of operation shall provide terminals for connecting normally closed remote safety devices. This emergency shutdown shall operate in any mode of operation.

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which variable speed drive is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 INSTALLATION

- A. General: Install systems and materials in accordance with manufacturer's instruction.
- B. Maintain minimum clearance of 12 inches on each side and 36 inches in front of the variable speed drive.
- C. Install variable speed drive in the vertical position.
- D. Provide separate conduits for input and output power cables.
- E. Provide separate conduits for control cables and the output cables to the motor.
- F. Install power and control cabling in separate conduits.
- G. Provide dedicated conduits for power cables to the motors.
- H. Load Side Disconnects: Provide a disconnect switch on the load side of the VFD near the motor for ease of service and safety. Disconnect switch shall be lockable in the open position when the VFD is not within sight of the motor. Operating the switch with the VFD running shall not cause any component failure. In dual motor applications, VFD shall be able to operate either motor with the other motor disconnected without requiring jumpers, parameter modifications, or other adjustments. As part of start-up, VFD supplier shall certify all load side disconnects can be opened or closed with drive running at full speed without damage to the drive.
 1. When a separate disconnect is provided at the motor, provide auxiliary contact in the disconnect switch that will shut down the variable speed drive when the disconnect switch is turned off.

3.3 START UP

- A. All units shall be started up at the jobsite by a factory trained and authorized representative.

3.4 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of two hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
 1. Overview of the system and/or equipment as it relates to the facility as a whole.
 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."
- C. Certification: Contractor shall submit to the Engineer a certification letter written by the Contractor stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed

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by the Contractor and the Owner's representative indicating agreement that the training has been provided. Copies of the startup report shall be attached to the certification letter.

- D. Schedule: Schedule training with Owner with at least 14 days' advance notice.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components.
- B. Miscellaneous materials.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 5. Notify Architect of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured.

1.3 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for each type of hanger and support. Include a hanger and support schedule showing manufacturer's figure number, size, location, and features for each hanger and support. Submit style and type to Structural Engineer for approval prior to installation.
- B. Product Certificates: Signed by the manufacturer of hangers and supports certifying the products meet the specified requirements.
- C. Maintenance Data: For inclusion in Operating and Maintenance manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."
- D. Shop Drawings: Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution. Include dimensions, weights, required clearances, and method of assembly.
 - 1. Application of protective inserts, saddles, and shields at pipe hangers for each type of insulation and hanger.
- E. Installer's Qualifications: Include evidence of compliance with specified requirements.
- F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 QUALITY ASSURANCE

- A. Comply with applicable building code.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Installer Qualifications for Field-Welding:

1. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel."
 2. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.
 3. Qualify welding processes and welding operators in accordance with ASME BPVC Section IX, "Welding and Brazing Qualifications."
- D. Flame/Smoke Ratings: Provide hangers and supports with flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.5 DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 - PRODUCTS AND MATERIALS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Comply with MSS SP-58.
 2. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of work.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported. Include consideration for vibration, equipment operation, and shock loads where applicable.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Materials: Products and materials listed in this specification are based on indoor, dry locations. Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Carbon steel, galvanized steel, zinc-plated steel or approved equivalent where installed for piping and equipment that will not have a factory-applied or field-applied finish, unless otherwise indicated.
 - a. Indoor Damp or Wet Locations: Galvanized steel, painted steel, Type 304 stainless steel, or aluminum.
 - b. Natatorium or other treated pool environments: Aluminum.
 - c. Outdoor Locations: Type 304 stainless steel, galvanized steel, aluminum, or approved equivalent.
 - d. Dielectrics Barriers: Provide dielectric barriers between metallic supports and metallic piping and associated items of dissimilar type. Acceptable barriers include rubber, or copper-plated coatings where attachments are in direct contact with copper.
 - e. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - f. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
 - g. Stainless Steel: Type 304 in accordance with ASTM A240.
- B. Metal Channel (Strut) Framing Systems:
1. Manufacturers:
 - a. Cooper B-Line.

- b. Ferguson Enterprises/FNW.
 - c. PHD Manufacturing.
 - d. Thomas & Betts Corporation.
 - e. Unistrut, a brand of Atkore International Inc.
 - f. Source Limitations: Furnish channels (struts) and associated fittings, accessories, and hardware produced by a single manufacturer.
2. Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 3. Comply with MSS SP-69, Type 59, MSS SP-89, and . Welds shall comply with AWS D1.1.
 4. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use stainless steel, aluminum, or galvanized steel.
 - c. All nuts, brackets, and clamps shall have the same finish as the channel.
 5. Minimum Channel Thickness: Steel sheet, 14 gage, 0.0747 inch.
 6. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height with factory-punched attachment holes.
 7. Provide plastic galvanic isolators for connecting bare copper pipe for use with pre-engineered support strut system where indicated.

2.2 MISCELLANEOUS MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36.
- B. Malleable Iron: ASTM A47
- C. Cement Grout: Portland cement (ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ASTM C 404, Size No. 2). Mix ratio shall be 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Provide independent support from building structure. Do not provide support from piping, ductwork, conduit, or other systems.
- C. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.

3.3 INSTALLATION OF HANGERS AND SUPPORTS

- A. Install in accordance with ASME B31.9, ASTM F708, or MSS SP-58 unless indicated otherwise.
- B. If type of hanger or support for a particular situation is not indicated, select appropriate type using MSS SP-58 recommendations.
- C. Space attachments within maximum piping span length specified in Division 23 piping sections.
- D. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- E. Install hangers, supports, clamps and attachments to support piping properly from building structure.

- F. Do not attach to ceilings, equipment, ductwork, conduit and other non-structural elements such as floor and roof decking.
- G. Install building attachments within concrete or to structural steel.
 - 1. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping as specified in Division 23 piping sections.
 - 2. Install concrete inserts before concrete is placed; fasten insert to forms. Where concrete with compressive strength less than 2,500 psi is indicated, install reinforcing bars through openings at top of inserts.
- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Provide two nuts on threaded supports to securely fasten the support.
- I. Install appropriate types of hangers and supports to allow controlled 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.
- J. Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.4 EQUIPMENT SUPPORT AND ATTACHMENT

- A. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
- B. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls.
- C. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
- D. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- E. Preset Concrete Inserts and Expansion Anchors: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - 1. Where concrete slabs form finished ceiling, locate anchors flush with slab surface.
- F. Secure fasteners according to manufacturer's recommended torque settings.
- G. Remove temporary supports.
- H. Fabricate structural steel supports to suspend equipment from structure above or support equipment from floor.
- I. Grouting: Place grout under supports for piping and equipment.

3.5 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Install and align fabricated anchors in indicated locations.
- 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 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work, and 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 that no roughness shows after finishing, and so that contours welded surfaces to match adjacent contours.

3.6 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Touch-Up Painting: Immediately after erection of anchors and supports, clean field welds and abraded areas of shop paint and paint exposed areas with same material as used for shop painting to comply with SSPC-PA-1 requirements for touch-up of field-painted surfaces. Comply with Division 09 Section "Painting."
 - 1. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- E. For galvanized surfaces clean welds, bolted connections and abraded areas and apply galvanizing repair paint to comply with ASTM A 780.
- F. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 230529

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.
- D. Engraved plastic-laminate signs.

1.2 SUBMITTALS

- A. Custom Signage: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- B. Product Data: Submit manufacturer's technical product data for each product required.
- C. Manufacturer's Installation Instructions: Indicate special procedures and installation for each product required.

PART 2 - PRODUCTS AND MATERIALS

2.1 ACCEPTABLE MANUFACTURERS

- A. Advanced Graphic Engraving, LLC.
- B. Brady Corporation.
- C. Brimar Industries, Inc.
- D. Craftmark.
- E. Industrial Safety Supply Co., Inc.
- F. Kolbi Pipe Marker Co.
- G. MIFAB, Inc.
- H. Seton Identification Products, a Tricor Direct Company..

2.2 IDENTIFICATION APPLICATIONS AND REQUIREMENTS

- A. General:
 - 1. Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 23 sections. Where more than a single type is specified for application, selection is the installer's option, but provide single selection for each product category.
 - 2. Lettering: Coordinate names, abbreviations, and other designations used in mechanical identification work with the corresponding designations shown on the drawings, scheduled, and specified. If not otherwise indicated, provide numbering, lettering, and wording as recommended by the manufacturer or as required for proper identification, operation, and maintenance of mechanical systems and equipment.

3. Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (e.g., Boiler No. 3, Air Supply No. 1H, etc.).
- B. Air Handling Units: Nameplates or engraved plastic laminate signs.
- C. Automatic Controls: Tags, use the same naming convention coordinated with the building automation system.
- D. Control Panels: Nameplates.
- E. Dampers: Ceiling tacks where located above lay-in ceiling. Do not use ceiling tacks in a gyp ceiling.
- F. Ductwork: Adhesive-backed duct markers.
- G. Instrumentation: Tags.
- H. Major Control Components including Variable Frequency Drives: Nameplates or engraved plastic laminate signs.
- I. Relays: Tags.
- J. Thermostats: Nameplates.
- K. General Signs: Engraved plastic laminate signs.

2.3 NAMEPLATES

- A. Nomenclature: Include the following, matching terminology on schedules as closely as possible:
 1. Name and mark number.
 2. Equipment service.
 3. Design capacity.
 4. Other design parameters such as pressure drop, entering and leaving conditions, rpm, etc.
- B. Size: 2-1/2 inch x 4 inch for control panels and components, 4-1/2 inch x 6 inch for equipment.
- C. Letter Color: White.
- D. Letter Height: 1/4 inch.
- E. Background Color:
 1. Cooling equipment: Green.
 2. Heating equipment: Yellow.
 3. Combination cooling and heating equipment: Yellow/Green.
 4. Energy reclamation equipment: Brown.
 5. Hazardous equipment: Colors and designs recommended by ASME.
 6. Equipment and components that do not meet any of the above criteria: Blue.
- F. Plastic: Conform to ASTM D709.

2.4 TAGS

- A. Plastic Laminate Tags: Laminated three-layer plastic, minimum 3/32 inch thick, with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.

- B. Solid Plastic Tags: Solid plastic, minimum 3/32 inch thick, with printed black letters on white color. Tag size minimum 1-1/2 inch diameter and 5/32 inch hole for fastener.
- C. Metal Tags: Provide 19-gauge polished brass with stamped letters. Tag size minimum 1-1/2 inch diameter with smooth edges and 5/32 inch hole for fastener. Fill tag engraving with black enamel paint.
- A. Accident Prevention Tags: Pre-printed or partially pre-printed, of plasticized card stock with matte finish suitable for writing, minimum 3-1/4 inch x 5-5/8 inch size, with brass grommet in hole for fastener. Order with appropriate pre-printed wording (e.g., DANGER, CAUTION, DO NOT OPERATE, etc.).
- D. Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks of the size required for proper attachment of tags to valves, manufactured specifically for that purpose.
- E. Letter Height:
 - 1. System Abbreviation: Minimum 1/4 inch.
 - 2. Valve Number: Minimum 1/2 inch.

2.5 ADHESIVE-BACKED DUCT MARKERS

- A. Material: High gloss acrylic adhesive-backed vinyl film 0.0032 inch; printed with UV and chemical resistant inks.
- B. Style: Individual label.
- C. Nomenclature: Include air handling unit identification number, duct size, service, and arrows indicating direction of flow.
- D. Specialty Exhaust: Identify the specialty using the system terminology (e.g., Grease, Dishwasher, Dryer, Fume Hood, etc.).
- E. Color: Yellow background with black lettering or blue background with white lettering.
 - 1. Hazardous Exhaust: Use colors and designs recommended by ASME A13.1.

2.6 ENGRAVED PLASTIC-LAMINATE SIGNS

- A. General: Engraving stock melamine plastic laminate, engraved with manufacturer's standard letter style, black with white core letter color except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.
- B. Thickness: 1/16 inch thick for units up to 20 square inches, or 8 inches in length; 1/8 inch thick for larger units.
- C. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
- D. Nomenclature: When used to identify equipment, match terminology on schedules, including the following:
 - 1. Name and mark number.
 - 2. Equipment service.
 - 3. Design capacity.
- E. Access Panel Markers: Laminated three-layer plastic, minimum 1/16 inch thick and 1/8 inch hole for fastener, with abbreviations and numbers corresponding to concealed valve.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.
- B. Prepare surfaces in accordance with Division 09 for stencil painting.

3.2 GENERAL INSTALLATION

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install products in accordance with manufacturer's instructions.
- C. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- D. Identify service, flow direction, and pressure.

3.3 DUCTWORK IDENTIFICATION

- A. Install identification on the most obviously visible portion of the duct from the point of access.
- B. Location: Install ductwork identification where ductwork is exposed to view, concealed by a removable ceiling system, located in accessible maintenance spaces (shafts, tunnels, plenums, etc), and exterior non-concealed locations as follows:
 - 1. Within 5 feet of each control damper or balancing damper, excluding balancing dampers installed in duct take-offs to individual grilles, registers, or diffusers that are less than 25 feet in lengths and installed in the same space as the air device.
 - 2. Within 5 feet of each branch duct, excluding branch ducts that are less than 25 feet in length and located in the same space as the main duct.
 - 3. Within 5 feet of each side of a penetration of a wall, floor, ceiling, structure, or enclosure.
 - 4. Spaced intermittently at a maximum spacing of 50 feet along each duct run. Reduce spacing to 25 feet in congested areas when there are more than two types of duct systems or pieces of equipment.
 - 5. Within 5 feet of equipment outlets and other points of origin or termination.
 - 6. Install marker on the most obviously visible portion of the duct from point of access.

3.4 ACCESS DOOR IDENTIFICATION

- A. Provide identification on each access door, indicating purpose of access, maintenance and operating instructions, and appropriate safety and procedural information.
- B. Where access doors are concealed above a removable ceiling system or similar concealment, tags may be used in lieu of specified identification.

3.5 EQUIPMENT IDENTIFICATION

- A. Install nameplates and engraved plastic laminate signs for identification of equipment. Provide additional signs and lettering as follows:
 - 1. To distinguish between multiple units in close proximity.
 - 2. To inform operator of operational requirements.
 - 3. To indicate safety and emergency precautions.

4. To warn of hazards and improper operations.
- B. Adjust lettering size based on viewing distance from normal location of identification:
1. Less than 2 feet: Minimum 1/4 inch.
 2. Up to 6 feet: Minimum 1/2 inch.
 3. Greater than 6 feet: Proportionally increase letter size based on recommendations above.
 4. Provide secondary lettering 2/3 to 3/4 of size of principal lettering.
 5. Stencils may be used in lieu of nameplates when lettering greater than 1 inch is needed for proper identification because of distance from normal location of required identification.
- C. Where equipment to be identified is concealed above acoustical ceilings or similar removeable concealment, equipment tags may be installed in the concealed space to reduce the amount of text in exposed sign.

END OF SECTION 230553

SECTION 230593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. General testing, adjustment, and balancing requirements.
- B. Testing, adjustment, and balancing of air systems.
- C. This section excludes:
 - 1. Testing boilers and pressure vessels for compliance with safety codes;
 - 2. Specifications for materials for patching mechanical systems;
 - 3. Specifications for materials and installation of adjusting and balancing devices. If devices must be added to achieve proper adjusting and balancing, refer to the respective system sections for materials and installation requirements.
 - 4. Requirements and procedures for piping and ductwork systems leakage tests.

1.2 DEFINITIONS

- A. TAB: Testing, adjusting, and balancing.
- B. Test: To determine quantitative performance of equipment.
- C. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment (e.g., reduce fan speed, throttling).
- D. Balance: To proportion flows within the distribution system (submains, branches, and terminals) according to specified design quantities.
- E. Procedure: Standardized approach and execution of sequence of work operations to yield reproducible results.
- F. Report forms: Data sheets arranged for collecting test data in logical order for submission and review. Data should also form the permanent record to be used as the basis for required future testing, adjusting, and balancing.
- G. Terminal: The point where the controlled fluid enters or leaves the distribution system. Examples include inlets and outlets on water terminals, inlets and outlets from air terminal units, and inlets and outlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- H. Main: Duct or pipe containing the major or entire fluid flow of the system.
- I. Submain: Duct or pipe containing part of the system capacity and serving two or more branch mains.
- J. Branch main: Duct or pipe serving two or more terminals.
- K. Branch: Duct or pipe serving a single terminal.

1.3 SUBMITTALS

- A. Qualifications:
 - 1. Submit qualifications of TAB agency.
 - 2. Submit qualifications of TAB supervisor.

- B. TAB Plan: Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
- C. Sample Forms: Submit sample forms if they are other than the standard forms available from the certification association followed for the project.
- D. Control System Coordination Reports: Communicate in writing to the controls installer all setpoint and parameter changes made or problems and discrepancies identified during TAB that affect, or could affect, the control system setup and operation.
- E. Progress Reports.
- F. Certified TAB Reports:
 - 1. General:
 - a. Submit within two weeks after completion of testing, adjusting, and balancing.
 - b. Revise TAB plan to reflect actual procedures and submit as part of final report.
 - c. Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 2. Draft Report: Submit draft copies of report for review prior to final acceptance of Project. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in the same manner specified for the final reports. Submit 2 complete sets of draft reports. Only 1 complete set of draft reports will be returned.
 - 3. Final Report: Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports. The final report shall be certified proof of the following:
 - a. The systems have been tested, adjusted, and balanced in accordance with the referenced standards.
 - b. The report reflects an accurate representation of how the systems have been installed.
 - c. The report reflects a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures.
 - d. The report is an accurate record of all final quantities measured to establish normal operating values of the systems.
 - 4. Report Format: Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, and cover identification at front and side. Include set of reduced size drawings indicating air outlets, equipment, and thermostat locations identified to correspond with report forms. Divide the report into the following divisions:
 - a. General Information and Summary
 - 1) Include project name, location, altitude, and date.
 - 2) Identify TAB agency, contractor, owner, architect, and engineer.
 - 3) Include addresses, contact names, and telephone numbers.
 - 4) Include certification sheet containing the seal, name, address, telephone number, and signature of the certified TAB Supervisor.
 - 5) Include actual instrument list, with manufacturer name, serial number, and date of calibration.
 - b. Air Systems
 - c. Hydronic Systems

- d. Temperature Control Systems
 - e. Special Systems
 - f. Sound and Vibration Systems
5. Report Forms: Standard forms prepared by the TAB certification standard being followed for each respective item and system to be tested, adjusted, and balanced. If not specified, follow ASHRAE 111.
6. Units of Measure: Report data in I-P (inch-pound) units only.
- G. Project Record Documents: Provide drawings that record actual locations of flow measuring stations and balancing devices.

1.4 QUALITY ASSURANCE

- A. Comply with ASHRAE Standard 111, Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
- B. Comply with ASHRAE Handbook, HVAC Applications Volume, Chapter "Testing, Adjusting, and Balancing", most current edition.
- C. TAB Agency Qualifications:
- 1. Act as the single source of responsibility for TAB of the HVAC systems.
 - 2. Staff the project at all times by qualified personnel.
 - 3. Have a minimum of 5 years documented experience on projects with TAB requirements similar to those required for the project.
 - 4. Certified by one of the following Certification Associations:
 - a. AABC (NSTSB): Associated Air Balance Council, National Standards for Total System Balance.
 - b. NEBB: National Environmental Balancing Bureau, Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - c. TABB: Testing, Adjusting, and Balancing Bureau, SMACNA TAB Procedural Guide.
- D. TAB Supervisor and Technician Qualifications:
- 1. Certified by the same organization as TAB agency.
 - 2. TAB Supervisor shall be a professional engineer licensed in the state in which the project is located.
- E. Pre-Qualified TAB Agencies:
- 1. AccuTech
 - 2. Doyle Field Services.
 - 3. Pro Balance.
 - 4. Total Air Balance.

PART 2 - PRODUCTS AND MATERIALS – NOT USED

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Begin work after systems to be tested, adjusted, or balanced are fully operational, duct systems are sealed, piping systems have been tested for leaks, and equipment is operational. Complete work prior to Substantial Completion of the project.
- B. Test, adjust, and balance the air systems before hydronic, steam, and refrigerant systems.
- C. Coordinate with Division 22 drawings for testing, adjusting, and balancing scope of work.
- D. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- E. Submit progress reports at least once a week to the General Contractor to communicate status of work so that the TAB work is completed in a timely manner.
- F. Notice of Tests: Provide seven days advance notice for each test. Include scheduled test dates and times.
- G. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and control, coordinate scheduling and testing and inspection procedures with the authorities having jurisdiction.
- H. All required instrumentation shall be calibrated to tolerances specified in the referenced standards within a period of six months prior to starting the project.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Motors and bearings are lubricated.
 - 5. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 6. Duct systems are clean of debris.
 - 7. Fans are rotating correctly and belts have tension.
 - 8. Fire, smoke, fire/smoke, and volume dampers are in place and open.
 - 9. Air coil fins are cleaned and combed.
 - 10. Volume dampers are installed at locations needed for balancing the air systems.
 - 11. Access doors are closed and duct end caps are in place.
 - 12. Air outlets are installed and connected.
 - 13. Visually inspect duct systems to ensure they are sealed and leakage is minimized.

B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.

C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

A. Pre-Balancing Conference: Prior to beginning of the testing, adjusting, and balancing procedures, schedule and conduct a coordination meeting with all installers whose work will be tested, adjusted, or balanced.

B. Furnish all instruments required for testing, adjusting, and balancing operations.

1. Verify all instruments have been calibrated.

2. Furnish instruments as recommended by the manufacturer for the TAB application.

3. Furnish instruments that are best suited to the function being measured.

4. Furnish instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

C. Furnish additional balancing devices as required for TAB to the appropriate contractor for installation.

D. Obtain copies of approved shop drawings of air handling equipment, terminal outlets, and temperature control diagrams.

E. Obtain manufacturer's fan and terminal device outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.

F. Determine best locations in main and branch ductwork for most accurate duct traverses.

G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.

3.4 ADJUSTMENT TOLERANCES

A. Air Handling Systems: Balance main ducts and equipment to within plus or minus 5 percent of design airflow.

B. Air Outlets and Inlets: Balance branch ducts and terminal devices to within plus or minus 10 percent of design airflow.

3.5 RECORDING AND ADJUSTING

A. Record data regarding design conditions from contract documents and installed conditions from shop drawings including equipment identification number, model number, location, area served, manufacturer, model number, serial number, motor nameplate horsepower and rpm, fan rpm, capacity and electrical voltage, amps and phases.

B. For all systems measure and record the ambient conditions at the time of testing and balancing. Include the following:

1. Dry bulb temperature.

2. Relative humidity.

3. Cloud cover.

4. Wind speed.

5. Time.

C. Field Logs: Maintain written logs including:

1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- D. Ensure recorded data represents actual measured or observed conditions.
- E. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- F. Mark on drawings the locations where traverse and other critical measurements were taken and cross reference the location in the final report.
- G. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- H. Cut insulation around ductwork and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.
- I. Patch and seal insulation, vapor barrier, ductwork, and housings, using materials identical to those removed.
- J. Seal ducts and piping and test and repair leaks.
- K. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- L. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.
- M. Check and adjust systems approximately six months after final acceptance and submit report.
- N. When averaging values, take a sufficient quantity of readings which will result in a repeatability error of less than 5 percent. When measuring a single point, repeat readings until 2 consecutive values are obtained.
- O. Take all readings at eye level of the indicated value to prevent parallax.
- P. Use pulsation dampeners where necessary to eliminate error involved in estimating average of rapidly fluctuation readings.
- Q. Take measurements in the system where best suited for the task.
- R. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

3.6 AIR SYSTEM TESTING, ADJUSTMENT, AND BALANCING PROCEDURE

- A. Check filters for cleanliness.
- B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.
- C. Verify volume dampers are installed at locations needed for balancing the air systems.
- D. Prepare report test sheets for both fans and outlets. Obtain manufacturer's outlet factors and recommended procedures for testing. Prepare a summation of required outlet volumes to permit a crosscheck with required fan volumes.
- E. Determine best locations in main and branch ductwork for most accurate duct traverses.
- F. Place outlet dampers in the full open position.

- G. Prepare schematic diagrams of system "as-built" ductwork and piping layouts to facilitate reporting.
- H. Lubricate all motors and bearings.
- I. Check fan belt tension.
- J. Check fan rotation.
- K. Energize fan motors and adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude. Replace fan and motor pulleys as required to achieve design conditions.
- L. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- M. Measure air quantities at air inlets and outlets.
- N. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- O. Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Affect volume control by duct internal devices such as dampers and splitters.
- P. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- Q. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- R. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- S. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- T. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- U. Where modulating dampers are provided, take measurements and balance at design conditions. Balance variable volume systems at design air flow rate and at minimum air flow rate.
- V. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship to maintain building pressure setpoint.
- W. Procedure for establishing minimum and absolute minimum outdoor air damper position on air handling units:
 - 1. Open the minimum outdoor air damper and return air damper fully. Close the economizer air damper.
 - 2. Operate supply fan at design speed and measure the outdoor airflow.
 - 3. If the outdoor airflow is above the scheduled minimum ventilation airflow, adjust the damper linkage on the minimum outdoor air damper so that outdoor airflow equals the scheduled minimum ventilation airflow with damper fully stroked.
 - 4. If outdoor airflow is below the scheduled minimum ventilation airflow, adjust the damper linkage on the return air damper so that outdoor airflow equals the schedule minimum ventilation airflow with the damper fully stroked.
 - 5. Convey the measured setpoint and/or damper position to the BAS installer and note on air balance report.
 - 6. Repeat this procedure to determine damper position for absolute minimum ventilation.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

END OF SECTION 230593

SECTION 230700
HVAC INSULATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. External Ductwork Insulation.

1.2 RELATED REQUIREMENTS

- A. Division 23 Section "Hangers & Supports for HVAC Piping & Equipment," for insulation shields, pipe saddles, and high-density insulation inserts.
- B. Division 23 Section "Metal Ducts" for duct liner insulation.

1.3 DEFINITIONS

- A. Cold Duct: Ductwork that carries airflow with a minimum operating temperature less than 65 degrees F temperature.
- B. Hot Duct: Ductwork that carries airflow with a minimum operating temperature greater than 75 degrees F temperature.
- C. Exposed: Insulation that is visible from the occupied space.
- D. Exposed to Weather: Insulation that is exposed to potential damage caused by weather, including sunlight, moisture, wind, and solar radiation.
- E. Exterior: Locations outside of or within the building envelope (walls, roof, floors, etc) as defined by the architectural drawings and specifications.
- F. Unconditioned Spaces: An enclosed space within a building that is not provided with mechanical heating or cooling.

1.4 SUBMITTALS

- A. Product Data: Submit technical product data, thermal characteristics, and materials for each type of mechanical insulation.
- B. Insulation Schedule: Include product name, conductivity k-value, thickness, and furnished accessories for each service.
- C. Maintenance Data: Submit maintenance data and replacement material lists for each type of mechanical insulation. Include this data and product data in maintenance manual.
- D. Manufacturer's Instructions: Include installation instructions for storage, handling, protection, examination, preparation, and installation of the product.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualification: Company specializing in manufacturing the products specified in this section with not less than three years of documented experience.
- B. 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.

- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less and smoke-developed index of 50 or less, as tested by UL 723 or ASTM E84 (NFPA 255) method.
 - 1. Exception: Exterior mechanical insulation may have flame spread index of 75 and smoke developed index of 150.
 - 2. Exception: Industrial mechanical insulation that will not affect life safety egress of building may have flame spread index of 75 and smoke developed index of 150.
 - 3. Exception: Polyisocyanurate insulation that is not installed in a return air plenum may have a flame spread index of 25 and smoke developed index of 450.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site, labeled with manufacturer's identification, product density, and thickness.
- B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage; store in original wrapping.

1.7 FIELD CONDITIONS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during, and after installation for minimum of 24 hours.

PART 2 - PRODUCTS

2.1 EXTERNAL DUCTWORK INSULATION MATERIALS

- A. Rigid Mineral Fiber (rock, slag, or glass):
 - 1. Manufacturers:
 - a. Johns Manville.
 - b. Knauf Insulation.
 - c. Owens Corning.
 - 2. Insulation: ASTM C612, Type IA or IB, rigid mineral fiber board.
 - a. K-value: ASTM C518 or C177, maximum 0.25 at 75 degrees F.
 - b. Minimum Service Temperature: 0 degrees F
 - c. Maximum Service Temperature: 450 degrees.
 - d. Density:
 - 1) 3.0 pounds per cubic foot.
 - 3. Factory Applied Vapor Barrier Jacket: ASTM C1136, Type II.
 - a. All-Service Jacket (ASJ): Paper/Foil/Scrim, water vapor permeance of 0.02 perms.
 - b. Foil Scrim Kraft (FSK): Kraft paper with glass fiber yarn and bonded to aluminized film, water vapor permeance of 0.02 perms.
 - c. Polypropylene Scrim Polyester (PSP): Polyester paper with glass fiber yarn and bonded to polypropylene, water vapor permeance of 0.02 perms.
 - d. Color: White.

B. Flexible Elastomeric:

1. Manufacturers:
 - a. Aeroflex USA, Inc.
 - b. Armacell LLC.
 - c. K-Flex USA.
2. Insulation: ASTM C534, Grade 1, flexible elastomeric cellular rubber insulation, sheet form.
 - a. K-value: ASTM C518 or C177, maximum 0.28 at 75 degrees F.
 - b. Minimum Service Temperature: Minus 40 degrees F
 - c. Maximum Service Temperature: 180 degrees F.
3. Factory Applied Jacket:
 - a. Flexible Metal Cladding: Metallic factory-laminated cladding, 17.5 mils thick, designed to prevent damage to underlying insulation from sunlight, installation, and physical abuse, with water vapor permeance of 0.00 perms. Provide ArmaTuff or equal. Reference Duct Jacket Schedule in Part 3 of this specification for application of this jacket.

C. Field-Applied Jacket:

1. Aluminum: ASTM B209, 3003 alloy, H-14 temper, with 3-mil thick polyfilm moisture barrier to interior surface.
 - a. Thickness: 0.032 inch sheet.
 - b. Finish: Smooth or Stucco. Reference Part 3 for jacket applications.
 - c. Joining: Longitudinal slip joints and 2 inch laps.
 - d. Fittings: 0.032 inch thick die shaped fitting covers with factory attached protective liner.
 - e. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum or 0.010 inch thick stainless steel.
2. Multilayer Laminate Vapor Barrier Cladding: UV-resistant multi-ply outer layer and cold weather acrylic adhesive. Provide VentureClad Plus 1579 CW, Polyguard Zero-Perm, or approved equal.

D. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, pins with insulation retaining washers, anchors, corner angles and other appurtenances as recommended by insulation manufacturer for applications indicated.

E. Adhesives, Sealers, Mastics, and Protective Finishes: Provide cements, adhesives, coatings, sealers, mastics, protective finishes, and similar compounds as recommended by insulation manufacturer for applications indicated.

1. Mineral Fiber Lagging Adhesive: Comply with ASTM C916, Type 2 or MIL-A-3316C, Class 2, Grade A. Provide Foster 85-60, Childers CP-127, or equal water-based adhesive.
2. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.
3. Water-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 47 mils dry per ASTM E96. Provide Fosters 30-80, Childers CP-38, Design Polymerics 3040, or equal.

4. Solvent-Based Vapor Barrier Mastic: Comply with MIL-PRF-19565C, Type II, with water vapor permeance 0.05 perms or less at 35 mils dry per ASTM F 1249.
5. Tie Wire: Annealed steel, 16 gauge, 0.0508 inch diameter.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test piping and ductwork for design pressure, liquid tightness, and continuity prior to applying insulation materials.
- B. Verify that surfaces are clean and dry, with foreign material removed.

3.2 PROTECTION AND REPLACEMENT

- A. Provide all required protection for insulation (installed and uninstalled) throughout the duration of construction to avoid exposure to plaster, dust, dirt, paint, moisture, deterioration, and physical damage.
- B. Repair existing mechanical insulation that is damaged during this construction period. Use insulation of same type and thickness as existing insulation. Install new jacket lapping and sealed over existing.
- C. Replace damaged insulation which cannot be repaired satisfactorily at no additional expense to the Owner, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installation of new insulation that replaces the damaged or wet insulation.

3.3 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.

3.4 DUCTWORK INSULATION SYSTEM INSTALLATION

- A. Maintain continuous thermal and vapor-barrier integrity throughout entire installation and protect it from puncture and other damage.
- B. Install insulation on duct systems subsequent to painting, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces.
- D. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Install insulation without sag on underside of duct. Where rectangular ducts are 24 inches in width or greater, secure external insulation to the bottom of the duct with mechanical fasteners, spaced on 18 inches on center (maximum). Fasteners shall include 2-inch square self-sticking galvanized carbon-steel base plates with minimum 0.106-inch diameter zinc-coated, low carbon steel, fully annealed shank spindle, length to suit depth of insulation. Secure insulation to spindles with self-locking washers incorporating a spring steel insert to ensure permanent cap retention. Lift duct off trapeze hangers and insert spacers to avoid insulation compression.
- F. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- G. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.

H. Cold Ducts:

1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
2. Provide vapor barrier jacket according to the Ductwork Jacket Schedule.
3. Seal joints with vapor barrier mastic.
4. Continue insulation, including vapor barrier, through walls, sleeves, hangers, and other duct penetrations.
5. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.

I. Hot Ducts:

1. Insulate entire system, including fittings, joints, flanges, expansion joints, and air duct accessories.
2. Provide jackets with or without vapor barrier according to the Ductwork Jacket Schedule.
3. Secure joints with staples, tape, or wires.
4. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

J. Exterior Ductwork and Ductwork Exposed to Weather:

1. Slope ductwork to ensure that water cannot pond anywhere on the duct. Do not vary the insulation thickness to achieve drainage.
2. Jackets shall be approved by the jacket manufacturer for use with the specific insulation material it covers.
3. Locate longitudinal seams of jacket at bottom of duct. Install jacket in strict conformance with cladding manufacturer's instructions.
4. Seal joints with vapor barrier mastic and reinforcing mesh as recommended by manufacturer or protective jacket as specified.
5. Install aluminum jacket with three metal jacket bands per section.
6. Multilayer Laminate Vapor Barrier Cladding: Install cladding only when ambient temperature is above 50 degrees F. Provide low-temp products for installation in low ambient temperatures down to 10 degrees F.
7. Cover seams in flexible metal cladding with ArmaTuff seal tape or equal.

3.5 DUCTWORK SYSTEM INSULATION SCHEDULE

A. Supply Air:

1. Service:
 - a. Supply ducts from air handling equipment.
2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Flexible elastomeric.

B. Return Air:

1. Service:

- a. Interior ductwork within 10 feet of exterior roof or wall penetrations.
- 2. Acceptable Insulation:
 - a. Flexible mineral fiber.
 - b. Rigid mineral fiber.
 - c. Flexible elastomeric.
- C. Exterior Ductwork:
 - 1. Service:
 - a. Supply ductwork.
 - b. Return ductwork.
 - c. Plenums and unit housings not pre-insulated at factory or lined.
 - 2. Acceptable Insulation:
 - a. Flexible elastomeric.

3.6 DUCT SYSTEM INSULATION THICKNESS SCHEDULE

- A. Flexible Mineral Fiber:
 - 1. Interior Ductwork:
 - a. 1.5 pounds per cubic foot density:
 - 1) 2 inch thick, minimum R-6.0.
 - 2. Meet R-value installed at maximum 25% compression, application limited to concealed locations.
- B. Rigid Mineral Fiber:
 - 1. Interior Ductwork:
 - a. 3 pounds per cubic foot density:
 - 1) 1-1/2 inch thick, minimum R-6.0.
- C. Flexible Elastomeric:
 - 1. Interior Ductwork:
 - a. 1-1/2 inch thick, minimum R-6.0.
 - 2. Exterior Ductwork or Ductwork Exposed to Weather:
 - a. 2 inch thick, minimum R-8.0.

3.7 DUCTWORK JACKET SCHEDULE

- A. Exposed ductwork:
 - 1. Foil Scrim Kraft (FSK).
 - 2. All-Service Jacket (ASJ).
 - 3. Polypropylene Scrim Polyester (PSP).
 - 4. Flexible Metal Cladding (flexible elastomeric only).
 - 5. Aluminum with smooth finish.
- B. Exterior ductwork and ductwork exposed to weather:

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HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

1. Flexible Metal Cladding (flexible elastomeric only).
2. Aluminum with stucco finish.
3. Multilayer Laminate Vapor Barrier Cladding.

END OF SECTION

SECTION 230913

INSTRUMENTATION AND CONTROL DEVICES FOR HVAC

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Control panels.
- B. Control dampers.
- C. Operators.
- D. Flow measuring apparatus.
- E. Humidistats.
- F. Input/Output sensors and transmitters.
- G. Output control devices.
- H. Power Supplies.
- I. Thermostats.
- J. Time clocks.

1.2 DEFINITIONS

- A. BAS: Building Automation System.
- B. Control Wiring: Includes conduit, wire and wiring devices to install complete control systems including motor control circuits, interlocks, thermostats, EP and IP switches and like devices. Includes all wiring from Intelligent Devices and Controllers to all sensors and points defined in the input/output summary shown on the drawings or specified herein and required to execute the sequence of operations
- C. DDC: Direct Digital Control.
- D. EPDM: Ethylene Propylene Diene Monomer.
- E. High voltage: 50 volts or higher.
- F. Low voltage: Below 50 volts.
- G. PTFE: Polytetrafluoroethylene.
- H. TEFZEL: A modified ETFE (ethylene tetrafluoroethylene) fluoroplastic.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Reference Division 23 Section "Electrical Coordination for Mechanical Equipment" for contractor responsibilities.
- B. BAS Contractor:
 - 1. Installation of the BAS shall be by the BAS Contractor or his subcontractors.
 - 2. Low voltage control wiring.
 - 3. Coordinate high voltage control wiring to instrumentation and control devices with Division 26. Where high voltage power is required for instrumentation and control devices that is in addition to what is shown on the drawings, the BAS contractor shall cover the cost of providing this wiring.
 - 4. All interlock wiring regardless of voltage (e.g., exhaust fan interlocked to supply fan).
 - 5. Coordinate with Division 26 that motor starters are provided with auxiliary contacts as required for interlocks.
 - 6. Coordinate power wiring to BAS controllers and instrumentation and control devices with Division 26.

7. Coordinate installation of back-box rough-in for wall-mounted control devices sensors, etc. with Division 26. Coordinate with mechanical contractor all locations, quantities, and sizes required for installation by Division 26.
 - C. Sheet Metal Contractor:
 1. Installation of automatic control dampers and necessary blank off plates.
 2. Access doors where and as required.
 - D. Mechanical Contractor:
 1. Installation of immersion wells.
 2. Installation of pressure tapings and associated shut-off cocks.
 3. Coordinate conduit and wall box rough-in, power wiring and magnetic starter requirements for controls and mechanical equipment with Division 26.
- 1.4 SUBMITTALS
- A. Refer to Division 01 for submittal procedures.
 - B. Product Data: Provide description and engineering data for each control system component. Include dimensions, capacities, size, performance characteristics, electrical characteristics, and finishes of materials.
 - C. Shop Drawings: Indicate complete operating data, system drawings, wiring diagrams, and written detailed operational description of sequences. For automatic dampers indicate arrangement, velocities, and static pressure drops for each system.
 - D. Manufacturer's Instructions: Provide for all manufactured components.
 - E. Operation and Maintenance Data: Include inspection period, cleaning methods, recommended cleaning materials, and calibration tolerances.
 - F. Project Record Documents: Record actual locations of control components, including panels, thermostats, and sensors. Accurately record actual location of control components, including panels, thermostats, and sensors.
 - G. Warranty: Submit manufacturer warranty and ensure forms have been filled out in Owner s name and registered with manufacturer.
- 1.5 QUALITY ASSURANCE
- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
 - B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
 - C. Measurement devices and sensors shall be calibrated using NIST traceable standards.
- 1.6 WARRANTY
- A. Correct defective Work within a one year period after Substantial Completion.
 - B. Provide extended warranty for control devices and equipment as specified herein.

PART 2 - PRODUCTS

2.1 CONTROL DAMPERS

- A. Dampers shall be factory fabricated and sized as shown on drawings and as specified.
- B. Individual damper sections shall not be larger than 48 inches x 60 inches. Provide a minimum of one damper actuator per section.
- C. Performance: Test in accordance with AMCA 500-D.
 1. Pressure Drop: Unless otherwise scheduled or indicated on the Drawings, size control dampers as follows:

- a. Modulating Dampers: Provide dampers with linear flow characteristics. Size modulating dampers based on the smaller of the following.
 - 1) Maximum velocity of 1,500 feet per minute.
 - 2) Maximum Full-open air pressure drop of 0.1 inches W.C.
 - b. Two Position Dampers: Dampers shall be full duct size and selected to minimize pressure drop.
2. Leakage:
- a. Motorized dampers shall not exceed 4.0 CFM/square foot in full closed position at 1 inch W.G. pressure differential across damper.
- D. Frames: Galvanized steel, extruded aluminum, or stainless steel, welded or riveted with corner reinforcement.
1. Use minimum 16 gauge for rectangular dampers.
 2. Use minimum 20 gauge for round dampers.
 3. For aluminum frames, use 1/8 inch thick material.
 4. All damper frames shall have a flange for duct mounting.
 5. Reference Part 3 Execution for application of the material type.
- E. Blades: Galvanized steel, extruded aluminum, or stainless steel, maximum blade size 6 inches wide, 48 inches long, attached to minimum 1/2 inch shafts with set screws.
1. Use minimum 16 gauge for rectangular dampers.
 2. Use minimum 16 gauge for round dampers.
 3. For aluminum blades, use 1/8 inch thick material.
 4. The blades shall be suitable for the air velocities to be encountered in the system.
 5. Dampers longer than the maximum blade length shall be fabricated in sections.
 6. Reference Part 3 Execution for application of the material type.
- F. Blade Seals: Synthetic elastomeric inflatable or Neoprene, mechanically attached, field replaceable.
1. Installed along the top and bottom of the frame and on all mating surfaces.
- G. Jamb Seals: Spring stainless steel.
1. Installed inside the frame sides.
- H. Shaft Bearings: One of the following as recommended by manufacturer for the application:
1. Oil impregnated sintered bronze.
 2. Graphite impregnated nylon sleeve with thrust washers at bearings.
 3. Lubricant free, stainless steel, single row, ground, flanged, radial, antifriction type with extended inner race.
 4. Molded synthetic bearings.
- I. Linkage Bearings: One of the following as recommended by manufacturer for the application:
1. Oil impregnated sintered bronze
 2. Graphite impregnated nylon.
- J. Maximum Pressure Differential: 6 inches wg.
- K. Temperature Limits: -40 to 200 degrees F.
- L. Manufacturers:
1. Greenheck.
 2. CESCO.
 3. Pottorff.

4. Nailor.
5. Ruskin.

M. Reference the Damper Schedule in Part 3 for basis of design damper model and material for the application.

2.2 OPERATORS

A. General:

1. Voltage: Voltage selection shall be as required to achieve the required torque for the application.
 - a. Reference Part 3 for Damper Operator Voltage Schedule.
2. Type: Motor operated, with or without gears. Motor type shall be continuous duty.
3. Construction:
 - a. For Actuators Less Than 100 W: Fiber or reinforced nylon gears with steel shaft, copper alloy or nylon bearings, and pressed steel enclosures.
 - b. For Actuators from 100 to 400 W: Gears ground steel, oil immersed, shaft hardened steel running in bronze, copper alloy or ball bearings. Operator and gear trains shall be totally enclosed in dustproof cast-iron, cast-steel or cast-aluminum housing.
 - c. For Actuators Larger Than 400 W: Totally enclosed reversible induction motors with auxiliary hand crank and permanently lubricated bearings.
4. Field Adjustment:
 - a. Spring Return Actuators: Easily switchable from fail open to fail closed in the field without replacement.
 - b. Gear Type Actuators: External manual adjustment mechanism to allow manual positioning when the actuator is not powered.
5. Two-Position Actuators: Single direction, spring return or reversing type. End-switches shall be integral to the actuator to determine actuator status.
6. Modulating Actuators:
 - a. Operation: Capable of stopping at all points across full range, and starting in either direction from any point in range.
 - b. Control Input Signal:
 - 1) Three Point, Tristate, or Floating Point: Clockwise and counter-clockwise inputs. One input drives actuator to open position and other input drives actuator to close position. No signal of either input remains in last position.
 - 2) Proportional: Actuator drives proportional to input signal and modulates throughout its angle of rotation. Suitable for zero- to 10-Vdc or 2- to 10-Vdc and 4- to 20-mA signals.
 - 3) Pulse Width Modulation (PWM): Actuator drives to a specified position according to pulse duration (length) of signal from a dry contact closure, triac sink, or source controller.
 - c. Programmable Multi-Function:
 - 1) Control Input, Position Feedback, and Running Time: Factory or field programmable.
 - 2) Diagnostic: Feedback of hunting or oscillation, mechanical overload, mechanical travel, and mechanical load limit.
 - 3) Service Data: Include, at a minimum, number of hours powered and number of hours in motion.
7. Position Feedback:

- a. Where indicated on the controls drawings, equip two-position actuators with limits switches or other positive means of a position indication signal for remote monitoring of open and close position.
 - b. Where indicated on the controls drawings, equip modulating actuators with a position feedback through current or voltage signal for remote monitoring.
 - c. Actuator shall contain position indicator and graduated scale indicating open and closed travel limits.
8. Integral Overload Protection:
- a. Provide against overload throughout the entire operating range in both directions.
 - b. Electronic overload, digital rotation sensing circuitry, mechanical end switches, or magnetic clutches are acceptable methods of protection.
9. Attachment:
- a. Unless otherwise required for valve interface, provide an actuator designed to be directly coupled to device without the need for connecting linkages.
 - b. Attach actuator to device drive shaft in a way that ensures maximum transfer of power and torque without slippage.
10. Temperature and Humidity:
- a. Temperature: Suitable for operating temperature range encountered by application.
 - b. Humidity: Suitable for humidity range encountered by application, non-condensing.
11. Enclosure:
- a. Suitable for ambient conditions encountered by application.
 - b. NEMA 4 for indoor wash-down or wet locations.
 - c. NEMA 4X, Belimo ZS-300, or equivalent; for outdoor applications.
 - d. Provide actuator enclosure with heater and control where required by application.
12. Stroke Time:
- a. Coordinate with stroke time indicated on the control drawings.
 - b. Unless otherwise noted, select operating speed to be compatible with equipment and system operation.
- B. Damper Operators:
1. Controls contractor shall size damper operator.
 2. Sizing: Provide smooth proportional control with sufficient power for air velocities 20 percent greater than maximum design velocity and to provide tight seal against maximum system pressures. Provide spring return for two position control and for fail safe operation.
 - a. Provide sufficient number of operators to achieve unrestricted movement throughout damper range.
 - b. Provide one operator for maximum 20 sq ft damper section or maximum 7 in-lb/sq ft damper area.
 3. Fail Positions:
 - a. Spring return to normal position as indicated on freeze, fire, temperature, or loss of power protection. Normal positions are indicated on the control drawings.
 - 1) Return air damper, normally open.
 - 2) Outside air damper, normally closed.
 - 3) Exhaust/Relief air damper, normally closed.
 - b. Operator shall fail in place for all other applications not listed under spring return.
 - c. Batteries, capacitors, and other non-mechanical forms of fail-safe operation are an acceptable alternate to spring return.

C. Manufacturers:

1. Damper Operators:
 - a. Belimo.
 - b. Honeywell.
 - c. Johnson Controls.
 - d. Schneider Electric (Invensys).
 - e. Siemens.

2.3 FLOW MEASURING APPARATUS

A. Airflow Measuring Stations

1. Sensor quantity and spacing shall comply with the Equal-Area or Log-Tchebycheff method as defined in the ASHRAE Handbook of Fundamentals.
2. Element Construction: Non-corrosive material such as stainless steel, aluminum, or cadmium-plated.
3. Stations and insertion elements utilizing thermal dispersion technology shall utilize hermetically sealed thermistors for each sensor and shall be factory calibrated to NIST traceable standards.
4. Stations and insertion elements using velocity pressure shall be tested and certified in accordance with AMCA 611.
5. Air Inlet Measuring Stations:
 - a. Intended for location within an air inlet to equipment, such as a hood or louver.
 - b. Elements:
 - 1) Element constructed of 316 stainless steel, factory mounted in a circular puck constructed of 14 gauge galvanized steel. Housing shall meet NEMA 1.
 - 2) Element shall not induce a measurable pressure drop, adversely affect fan performance or amplify the sound level within the fan system by its presence in the airstream.
 - 3) Element shall not be affected by the presence of moisture, dirt, or debris in the airstream and shall be unaffected by gusting wind.
 - 4) Density corrected for ambient temperature variances and atmospheric pressure due to altitude.
 - c. Range: Minimum 100 to 2,400 fpm.
 - d. Accuracy: Plus/minus 5.0 percent of reading within the calibrated airflow range.
 - e. Manufacturers:
 - 1) Air Monitor Corporation.
 - 2) Approved equal.
6. Duct Air Flow Measuring Stations
 - a. Located in a configuration and size equal to that of the duct it is installed.
 - b. The airflow traverse probe shall not induce a measurable pressure drop, nor amplify the sound level within the duct by its presence in the airstream.
 - c. Flow Straightener: Provide flow straightener as required by manufacturer of construction as needed to meet the application.
 - d. Range: Minimum 400 to 4,000 fpm.
 - e. Accuracy: Plus/minus 2.0 percent of the measured airflow.
 - f. Manufacturers:
 - 1) Air Monitor Corporation.

- 2) Ebtron.
- 3) Johnson Controls.
- 4) Paragon Controls.
- 5) Ruskin.
- 6) Sensocon.
7. Signal Processor:
 - a. Microprocessor-based, field programmable, capable of local display of the measured airflow rate.
 - b. Factory calibrated to NIST traceable standards.
 - c. Accuracy: 0.1 percent of full scale, including linearity, hysteresis, dead band, and repeatability.
 - d. Output: 0 to 10 Vdc or 4-20 mA scaled output signal for remote monitoring.

2.4 INPUT/OUTPUT SENSORS AND TRANSMITTERS

A. General:

1. Performance Requirements:
 - a. Device must be compatible with project DDC controllers.
 - b. Elements used shall be general-purpose type.
 - c. Provide transmitters or transducers with sensors as required, with range suitable for the system encountered.
 - 1) Transmitters and transducers shall have offset and span adjustments.
 - 2) Shock and vibration shall not harm the transmitter or transducer.
 - 3) Transmitters and transducers shall have a zeroing capability of readjusting the transmitter zero.
 - d. Accuracy requirements shall include the combined effects of linearity, hysteresis, repeatability, and the transmitter.
2. Output: Linear, proportional type over shielded cable pair, 4 - 20 mA or 0 – 10 Vdc signal.
3. Input Power: Low voltage, nominal 24 Vdc.

B. Temperature Sensors:

1. Use thermistor or RTD type temperature sensing elements with characteristics resistant to moisture, vibration, and other conditions consistent with the application without affecting accuracy and life expectancy. Sensor shall be UL 873 listed for temperature equipment.
2. Performance Requirements:
 - a. Thermistor:
 - 1) Accuracy (All): Plus/minus 0.36 degrees F minimum.
 - 2) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degrees F minimum.
 - 4) Heat Dissipation Constant: 2.7 mW per degree C.
 - 5) Drift: 0.04 degree F after 10 years within temperature range.
 - b. RTD:
 - 1) Construct RTD of nickel or platinum with base resistance of 1000 ohms at 70 degrees F. 100 ohm platinum RTD is acceptable if used with project DDC controllers.
 - 2) Accuracy (All): Plus/minus 1 degree F minimum, unless otherwise noted below.
 - a) Room Sensor Accuracy: Plus/minus 0.5 degrees F minimum.
 - b) Chilled Water Accuracy: Plus/minus 0.5 degrees F minimum.

- c) Temperature Differential Accuracy: Plus/minus 0.15 degrees F minimum.
 - 3) Resolution: Plus/minus 0.2 degree F.
 - 4) Drift: 0.04 degrees F after 10 years within temperature range.
- c. Sensing Range:
 - 1) Provide limited range sensors if required to sense the range expected for a respective point.
 - 2) Use RTD type sensors for extended ranges beyond minus 30 degrees F to 230 degrees F.
- d. Wire Resistance:
 - 1) Use appropriate wire size to limit temperature offset due to wire resistance to 1.0 degree F or use temperature transmitter when offset is greater than 1.0 degree F due to wire resistance.
 - 2) Compensate for wire resistance in software input definition when feature is available in the DDC controller.
- 3. Outside Air Sensors: Watertight inlet fitting shielded from direct rays of the sun.
- 4. Room Temperature Sensors:
 - a. Construct for surface or wall box, or enclosure with insulated backing suitable for exterior wall mounting.
 - b. Provide the following features:
 - 1) Integral digital display with the following:
 - a) Indication of space temperature.
 - b) Setpoint adjustment to accommodate room setpoint.
 - c) Display and control fan operation status.
 - d) Manual occupancy override and indication of occupancy status.
 - e) Controller mode status.
- 5. Temperature Averaging Elements:
 - a. Use on duct sensors for ductwork 10 sq ft or larger.
 - b. Use averaging elements where prone to stratification with sensor length range between 16-22 ft.
 - c. Provide for all mixed air and heating coil discharge sensors regardless of duct size.
- 6. Insertion Elements:
 - a. Use in ducts not affected by temperature stratification or smaller than 10 sq ft.
 - b. Provide dry type, insertion elements for liquids, installed in immersion wells, with minimum insertion length of 2.5 inches for pipe sizes greater than 4 inches.
- C. Humidity Sensors:
 - 1. Elements: Accurate within 3 percent full range with linear output.
 - a. Accuracy shall include temperature effects.
 - 2. Resolution: Plus/minus 1 percent.
 - 3. Drift: Less than 1 percent full scale per year.
 - 4. Sensing Range: 0 to 100 percent relative humidity.
 - 5. Room Sensors: Provide housing with integral sensor. Housing shall be plastic, NEMA 250, Type 1. Provide with insulated backing suitable for exterior wall mounting.
 - a. Cover: Provide display indicating sensed humidity value.
 - 6. Duct Sensors: Insertion type probe with mounting plate. Housing shall be metal, NEMA 250, Type 1.

7. Outside Air Sensors: With element guard and mounting plate.
- D. Pressure Transmitters:
 1. Duct Static Pressure:
 - a. Type: Unidirectional, fixed range.
 - b. Performance Characteristics:
 - 1) Accuracy: Plus/minus one percent of full scale.
 - 2) Thermal Effects: Temperature compensated over a minimum 40 to 120 F range. Zero and span shift of plus/minus 0.06 percent or less of full scale per degree F.
 - 3) Sensing Range: Select sensor so that the high end of the nominal sensor range is not less than 150 percent and not more than 300 percent of maximum expected input.
 - 4) Long Term Thermal Stability: Plus/minus one percent full scale per year.
 - c. Construction:
 - 1) Insertion or traverse type sensor suitable for use in flat oval, rectangular, and round duct configurations.
 - 2) Insertion length selected as appropriate for duct size.
 - 3) Traverse sensors shall have at least one pickup point every 6 inches.
 - 4) Element: Variable capacitance sensing technology.
 - 5) Housing: Fire retardant glass-filled polyester, brass, stainless steel, or aluminum.
- E. Equipment Operation Sensors:
 1. Status Inputs for Airside Equipment:
 - a. Type: Fixed range differential pressure switch with adjustable setpoint.
 - b. Performance Characteristics:
 - 1) Range: Not greater than two times the design fan static pressure.
 - c. Construction:
 - 1) Enclosure: Comply with NEMA enclosure ratings, suitable for the ambient conditions encountered.
 - 2) Provide Insertion tube for use in duct configurations. Insertion length selected as appropriate for duct size.
 - 3) Contact Type: Single-pole, single-throw (SPST). Provide multiple poles or throw contacts to meet additional alarms required.
 2. Status Inputs for Electric Motors:
 - a. Analog Current Transducer:
 - 1) Type: Split core design, cable of being installed or removed without dismantling the primary bus cables.
 - 2) Performance Characteristics:
 - a) Accuracy: Plus/minus 2 percent of selected range.
 - b) Range: Multi-range device, suitable for the amperage encountered with internal zero and span adjustment.
 - 3) Construction:
 - a) 24 V or Self-powered.
 - b) Provide with integral command relay.
 - c) Device shall accept overcurrent up to twice its trip into range.
 - d) Enclosure: UL 94 approved thermoplastic, rated for V-0. No metal parts shall be exposed other than the terminals.

- b. Binary Current Sensing Relay:
 - 1) Type: Split core with current transformers, adjustable and set to 175 percent of rated motor current.
 - 2) Self-powered with solid-state circuitry and a dry contact output.
 - 3) Adjustable trip point.
 - 4) Contact Type: Single-pole, double-throw (SPDT).
 - 5) LED indicating the on or off status.
 - 6) A conductor of the load shall be passed through the window of the device.
 - 7) Device shall accept overcurrent up to twice its trip into range.
- F. Carbon Dioxide Sensors:
 - 1. General: Provide non-dispersive infrared (NDIR) CO₂ sensors with integral transducers and linear output.
 - a. Linear, CO₂ Concentration Range Display: 0 to 2000 ppm.
 - b. Full Scale Accuracy: Plus/minus 75 ppm at concentrations of both 600 and 1,000 ppm when measured at sea level at 77 degrees F.
 - c. Maximum Response Time: 1 minute.
 - d. Analog Output: 0-10 Vdc or 4-20 mA.
 - e. Rated Ambient Conditions:
 - 1) Air Temperature: Range of 32 to 122 degrees F.
 - 2) Relative Humidity: Range of 0 to 95 percent (non-condensing).
 - 2. Calibration Characteristics:
 - a. Factory calibrated and certified by the manufacturer to require calibration not more frequently than once every 5 years.
 - b. Automatically compensating algorithm for sensor drift due to sensor degradation.
 - c. Sensor shall be temperature compensated throughout entire operating range.
 - d. Maximum Drift: 2 percent per year.
 - 3. Construction:
 - a. Sensor Chamber: Non-corrosive material for neutral effect on carbon dioxide sample.
 - b. Duct Mounting: Provide duct mounted sensors with duct probe designed to protect sensing element from dust accumulation and mechanical damage.
 - c. Wall/Surface Mounting: Construct for surface or wall box or enclosure suitable for wall mounting.

2.5 OUTPUT CONTROL DEVICES

- A. Control Relays:
 - 1. Provide relay with contact rating, configuration, and coil voltage that is suitable for the application.
 - 2. Provide NEMA 1 enclosure when relay is not installed in a local control panel.
 - 3. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator.
 - 4. Time delay relays shall be UL listed solid-state plug-in type with adjustable time delay. Delay shall be adjustable plus/minus 200 percent minimum from setpoint.
- B. Fan Speed Controllers:
 - 1. Solid-state model providing field-adjustable proportional control of motor speed. Equip with filtered circuit to eliminate radio interference.

2.6 POWER SUPPLIES

- A. Reference Division 23 Section "Direct Digital Controls for HVAC" for DC power supply requirements.
- B. Control power transformers shall meet NEMA/ANSI standards.
- C. Control power transformers shall be UL listed for Class 2 current-limited service or provided with over-current protection on both primary and secondary circuits for Class 2 current-limited service.
- D. Connected load on the transformer shall not exceed 80 percent of the transformer's rated capacity.
- E. The core and windings shall be completely encased in a UL approved thermoplastic. No metal parts shall be exposed other than the terminals.
- F. Performance Characteristics:
 - 1. Accuracy: Plus/minus 1 percent at 5.0 A full scale output.
- G. Provide a disconnect switch for each transformer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that systems are ready to receive work.
- C. Beginning of installation means installer accepts existing conditions.
- D. Sequence work to ensure installation of components is complementary to installation of similar components in other systems.
- E. Coordinate installation of system components with installation of mechanical systems equipment such as air handling units and air terminal units.

3.2 INSTALLATION

- A. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.
- B. General Workmanship:
 - 1. Install equipment, piping, and wiring/raceway parallel to building lines wherever possible.
 - 2. Provide sufficient slack and flexible connections to allow for vibration of piping and equipment.
 - 3. Install all equipment in readily accessible locations.
 - 4. All installations shall comply with industry specifications and standards for performance, reliability, and compatibility and be executed in strict adherence to local codes and standard practices.
 - 5. Install all products in accordance with manufacturer's instructions.
- C. Sensors:
 - 1. Mount sensors rigidly and adequately for the environment within which the sensor operates.
 - 2. Room temperature sensors shall be installed on concealed junction boxes properly supported by the wall framing. Coordinate installation of room/space sensors with architect and other trades to ensure a neat and orderly installation.
 - 3. All wires attached to sensors shall be air sealed in their raceways or in the wall to stop air transmitted from other areas affecting sensor readings.
 - 4. Sensors used in mixing plenums and hot and cold decks shall be of averaging type. Averaging sensors shall be installed in a serpentine manner vertically across the duct. Each bend shall be supported with a capillary clip.

5. Low-limit sensors used in mixing plenums shall be installed in a serpentine manner horizontally across duct. Each bend shall be supported with a capillary clip. Provide 1 foot of sensing element for each square foot of coil area.
 6. Do not install temperature sensors within the vapor plume of a humidifier. If installing a sensor downstream of a humidifier, install it at least 10 feet downstream.
 7. Install temperature, humidity, and smoke detectors for both supply air and return air applications a minimum of 10'-0" downstream or upstream of the air handling unit and prior to any branch duct takeoffs.
 8. All pipe-mounted temperature sensors shall be installed in wells. Install all liquid temperature sensors with heat-conducting fluid in thermal wells.
 9. Install outdoor air temperature sensors on north wall, complete with sun shield where shown on the plans. If not shown, locate sensors in an accessible location, a minimum of 15 feet away from exhaust or relief air locations.
 10. Differential air static pressure.
 - a. Supply Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the high-pressure tap tubing of the corresponding building static pressure sensor (if applicable) or to the location of the duct high-pressure tap and leave open to the plenum.
 - b. Return Duct Static Pressure: Pipe the high-pressure tap to the duct using a pitot tube. Pipe the low-pressure port to a tee in the low-pressure tap tubing of the corresponding building static pressure sensor or the plenum.
 - c. All pressure transducers, other than those controlling VAV boxes, shall be located in field device panels, not on the equipment monitored or on ductwork. Mount transducers in a location accessible for service without use of ladders or special equipment.
 - d. All air and water differential pressure sensors shall have gauge tees mounted adjacent to the taps. Water gauges shall also have shutoff valves installed before the tee.
 11. Check and verify location of thermostats, humidistats, and exposed control sensors with plans and room details before installation. Locate 48 inches above floor. Align with adjacent lighting switches and humidistats.
 - a. Install devices to meet ADA requirements unless otherwise noted on the plans.
 12. Mount outdoor reset thermostats and outdoor sensors indoors, with sensing elements outdoors with sun shield.
 13. Provide separable sockets for liquids and flanges for air bulb elements.
 14. Provide thermostats in aspirating boxes in areas where flush mounting is required.
 15. Provide guards on thermostats in areas indicated on the drawings.
 16. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
- D. Control Dampers:
1. Install dampers with extruded aluminum or stainless steel frames and blades in corrosive environments and areas with high humidity.
 2. Install smooth transitions, not exceeding 30 degrees, to dampers smaller than adjacent duct. Install transitions as close to damper as possible but at distance to avoid interference and impact to performance. Consult manufacturer for recommended clearance.
 3. Clearance:
 - a. Locate dampers for easy access and provide separate support of dampers that cannot be handled by service personnel without hoisting mechanism.
 - b. Install dampers with at least 24 inches of clear space on sides of dampers requiring service access.

4. Service Access:
 - a. Dampers and actuators shall be accessible for visual inspection and service.
 - b. Install access door(s) in duct or equipment located upstream of damper to allow service personnel to hand clean any portion of damper, linkage, and actuator. Comply with requirements in Division 23 Section, "Air Duct Accessories."
 5. Duct openings shall be free of any obstruction or irregularities that might interfere with blade or linkage rotation or actuator mounting.
 6. Install dampers straight and true, level in all planes, and square in all dimensions. Install supplementary structural steel reinforcement for large multiple-section dampers if factory support alone cannot handle loading.
 7. Provide mixing dampers of parallel blade construction arranged to mix streams. Where shown on the drawings, provide separate minimum outside air damper section adjacent to return air dampers with separate damper motor.
 8. Provide isolation (two position) dampers of parallel blade construction.
 9. Provide opposed blade damper configuration for all other applications.
 10. Install damper motors on outside of duct in warm areas. Do not install motors in locations at outdoor temperatures.
 11. After installation of low-leakage dampers and seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- E. Operators:
1. Mount and link control damper actuators according to manufacturer's instructions.
 - a. To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degrees open position, manually close the damper, and then tighten the linkage.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - c. Provide all mounting hardware and linkages for actuator installation.
 2. Dampers: Actuators shall be direct-mounted on damper shaft or jackshaft unless shown as a linkage installation. For low-leakage dampers with seals, the actuator shall be mounted with a minimum 5 degree available for tightening the damper seals.
- F. Control Panels:
1. Install control panels where shown on the drawings and where required to house controllers for the controlled systems and equipment.
 2. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. One cabinet may accommodate more than one system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and engraved plastic nameplates on cabinet face.
 3. Coordinate 120V power requirements with Division 26 to panels used for the building automation system and transformers for low voltage power to controllers.
- G. Install "hand/off/auto" selector switches to override automatic interlock controls when switch is in "hand" position.
- H. Provide an insulation standoff on control devices, cables, and other items that do not require flush mounting to ductwork, piping, or equipment.
- I. Install room pressure monitoring system per manufacturer installation instructions. Provide additional rough-in and tubing for accessories such as pressure snubbers and remote annunciators required to perform the system functions. Schedule manufacturer representative to provide start up, testing, and owner operating instructions to owner.

3.3 MAINTENANCE

- A. Provide service and maintenance of control system for one year from Date of Substantial Completion.
- B. Provide complete service of controls systems, including call backs, and submit written report of each service call.

3.4 STARTUP AND DEMONSTRATION

- A. Control Dampers and Valves:
 - 1. Stroke and adjust control valves and dampers following manufacturer's recommended procedure, from 100 percent open to 100 percent closed back to 100 percent open.
 - 2. Check and document open and close cycle times for applications with a cycle time of less than 30 seconds.
 - 3. For control valves and dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.
 - 4. Verify that all two-position dampers and valves operate properly and that the normal positions are correct.
 - 5. Verify that all modulating dampers and valves are functional, that the start and span are correct, that direction and normal positions are correct, and that they achieve proper closure.
- B. RUSKIN

<u>SERVICE</u>	<u>MODEL</u>	<u>MATERIAL</u>
Outside Air Control	CD-50	Aluminum
Fire and Smoke Control	FSD-60	Galvanized Steel
Corrosive Environments	CD-35	Aluminum or Stainless steel
All Other	CD-35	Galvanized Steel

3.5 DAMPER OPERATOR VOLTAGE SCHEDULE

<u>SERVICE</u>	<u>VOLTAGE</u>
Interlocked with HVAC fans	120V
Multi-section dampers	120V
Large dampers (> 60 inches in any dimension)	120V
All other operators control wiring	24V

- 1. Note: Coordinate with Division 26 if 120V power is required for operator to achieve appropriate torque requirements for damper actuation.

END OF SECTION

SECTION 230924

SMALL BUILDING CONTROL SYSTEM

PART 1 - GENERAL REQUIREMENTS

1.1 SECTION INCLUDES

- A. System Description. The main building automation system (Honeywell) shall interface with the packaged RTU controls for monitoring, alarms, and temperature adjustment. The integration should occur through BTL (BACnet Testing Labs) Certified. The integration will occur through the existing Honeywell PC-6A controller

PART 2 - PRODUCTS AND MATERIALS

2.1 SYSTEM DESCRIPTION

- A. Refer to the drawings for specification of the building automation control equipment and sequences associated with the equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Coordination:
 - 1. Cooperate with other contractors performing work on this project as necessary to achieve a complete and coordinated installation. Each Contractor shall consult the Drawings and Specifications for all trades to determine the nature and extent of others work.

3.2 STARTUP AND DEMONSTRATION

- A. Control system shall be set up and checked by factory trained technicians skilled in the setting and adjustment of the equipment used in this project. Technician shall be experienced in the type of HVAC systems associated with this project.
- B. At the completion of the startup, this contractor shall demonstrate the sequence of operations for each system to the Architect, Owner, or his representative.

3.3 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of eight hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
 - 1. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 - 2. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

C. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

SECTION 233113

METAL DUCTS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes:

1. Rectangular, round, and flat-oval metal ducts and plenums for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gauge.
2. Duct liner.
3. Wire rope hanging system.

B. Related Sections:

1. Division 23 Section "Identification for HVAC Piping & Equipment," for labeling and identification of metal ducts.
2. Division 23 Section "Common Work Results for HVAC," for materials and methods for wall penetrations and equipment pads.

1.2 DEFINITIONS

A. Sealing Requirements Definitions: For the purposes of duct systems sealing requirements specified in this Section, the following definitions apply:

1. **Seams:** A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.
2. **Joints:** Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A.** The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes or alterations to the layout or configuration of the duct system must be specifically approved in writing. Accompany requests for layout modifications with calculations showing that the proposed layout will provide the original design results without increasing the system total pressure.

1.4 SUBMITTALS

- A.** Product data including details of construction relative to materials, dimensions of individual components, profiles, and finishes for the following items:

1. Duct Liner.
2. Sealing Materials.

- B.** Shop drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.

2. Duct layout, indicating pressure classifications, duct gauge and sizes in plan view. For exhaust ducts systems, indicate the classification of the materials handled as defined in this Section.
 3. Fittings.
 4. Reinforcing details and spacing.
 5. Seam and joint construction details.
 6. Penetrations through fire-rated and other partitions.
 7. Locations of cleanout and access doors in grease exhaust ducts.
 8. Location of manual balancing dampers.
 9. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Coordination drawings for ductwork installation in accordance with Division 23 Section "General Mechanical Requirements." In addition to the requirements specified in "General Mechanical Requirements" show the following:
1. Coordination with ceiling suspension members.
 2. Spatial coordination with other systems installed in the same space with the duct systems.
 3. Coordination of ceiling- and wall-mounted access doors and panels required to provide access to dampers and other operating devices.
 4. Coordination with ceiling-mounted lighting fixtures and air outlets and inlets.
- D. Record drawings including duct systems routing, fittings details, reinforcing, support, and installed accessories and devices, in accordance with Division 23 Section "General Mechanical Requirements" and Division 1.
- E. Welding certificates including welding procedures specifications, welding procedures qualifications test records, and welders' qualifications test records complying with requirements specified in "Quality Assurance" below.

1.5 QUALITY ASSURANCE

- A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel" for hangers and supports and AWS D9.1 "Sheet Metal Welding Code."
- B. Qualify each welder in accordance with AWS qualification tests for welding processes involved. Certify that their qualification is current.
- C. NFPA Compliance: Comply with the following NFPA Standards:
 1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems," except as indicated otherwise.
 2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems.
- D. Sheet Metal and Air Conditioning Contractors' National Association, Inc. (SMACNA): Provide ductwork systems in conformance with "HVAC Duct Construction Standards – Metal and Flexible," latest edition.
- E. Underwriter's Laboratories (UL): Comply with the UL standards listed within this section. Provide mastic and tapes that are listed and labeled in accordance with UL 181A and marked according to type.
- F. National Air Duct Cleaners Association, Inc. (NADCA): Clean ductwork systems in accordance with the standard Assessment, Cleaning and Restoration of HVAC Systems (ACR 2002).

1.6 PROTECTION AND REPLACEMENT

- A. Protect ductwork during shipping and storage from dirt, debris and moisture damage. Provide plastic covers over ends of ductwork during shipping, storage and installation.
- B. Replace duct liner that is damaged and cannot be repaired satisfactorily, including insulation with vapor barrier damage and insulation that has been exposed to moisture during shipping, storage, or installation. Drying the insulation is not acceptable. Dry surfaces prior to installing new duct liner.

PART 2 - PRODUCTS AND MATERIALS

2.1 SHEET METAL MATERIALS

- A. Sheet Metal, General: Provide sheet metal in thickness indicated (minimum 26 gauge), packaged and marked as specified in ASTM A 700.
- B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 653, Coating Designation G 90. Provide mill phosphatized or galvanealed finish for surfaces of ducts exposed to view that is to be field painted. Provide bright galvanized finish for ductwork that is exposed to view and not field painted.
- C. Stainless Steel: ASTM A 480, Type 316, sheet form, with No. 4 finish on exposed surface for ducts exposed to view; Type 304, sheet form, with No. 1 finish for concealed ducts.
- D. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish where ducts are exposed to view, and mill finish for concealed ducts.
- E. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 DUCT LINER

- A. General:
 - 1. Comply with NFPA Standard 90A and North American Insulation Manufacturers Association (NAIMA) Standard AHC-101.
 - 2. Liner shall have a flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM E84 or UL 723.
 - 3. Duct sizes on mechanical plans indicate clear inside airflow dimensions. Sheet metal sizes for ductwork with duct liner shall be increased accordingly to account for liner thickness.
- B. Fiberglass: ASTM C 1071, Type I or II, glass fibers firmly bonded together with a thermosetting resin with surface exposed to airstream coated to prevent erosion of glass fibers. Liner surface shall serve as a barrier against infiltration of dust and dirt, shall meet ASTM C 1338 for fungi resistance and shall be cleanable using duct cleaning methods and equipment outlined by NAIMA Duct Cleaning Guide. Duct liner shall be rated for air velocity of 6,000 fpm.
 - 1. Rectangular fiberglass duct liner shall be Certainteed ToughGard T, JohnsManville Linacoustic RC, Knauf Atmosphere, Owens Corning QuietR or approved equal.
 - a. Thickness and Density:
 - 1) 1 inch, 1-1/2 pounds.
 - 2. Round fiberglass duct liner shall be Certainteed ToughGard UltraRound, JohnsManville Spiracoustic Plus, Owens Corning QuietZone Spiral, or approved equal.

- a. Thickness and Density:
 - 1) 1 inch, 4 pound.
3. Thermal Performance: Meet minimum "K-Factor" equal to 0.28 (Btu-in/h-sq ft-F) or better, at a mean temperature of 75°F and rated in installed condition in accordance with ASTM C518 and/or ASTM C177.
4. Noise Reduction Coefficient (NRC): Meet the following minimum NRC in accordance with ASTM C423 Type A Mounting:
 - a. 1 Inch Thick: NRC 0.65.
5. Liner Adhesive: Comply with NFPA Standard 90A /UL 181 classified with flame spread/smoke development less than 25/50 and ASTM C 916. Adhesive shall be a minimum 50% solid content, water-based, non-oxidizing and have a service temperature of -20 to 200 F. Water-based adhesive shall be one of the following:
 - a. Armacell LLC Armaflex 520 BLV low VOC.
 - b. Design Polymeric DP 2502.
 - c. Duro Dyne WIT.
 - d. Foster 85-60.
 - e. Childers CP-127.
 - f. Johns Manville SuperSeal HV.
 - g. Hardcast 951.
 - h. United McGill Uni-Tack.
6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct.
 - a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
 - b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

2.3 SEALING MATERIALS

- A. Joint and Seam Sealants, General:
 1. The term sealant used here is not limited to materials of adhesive or mastic nature, but also includes tapes and combinations of open weave fabric strips and mastics.
 2. Duct tape shall not be used as a sealant on any ducts.
 3. Sealants shall be ASTM E84 or UL 723 listed with a flame spread index not more than 25 and a smoke-developed index not more than 50.
- B. Joint and Seam Tape: 2 inches wide, glass-fiber-reinforced fabric.
- C. Tape Sealing System: Woven-fiber tape impregnated with a gypsum mineral compound and a modified acrylic/silicone activator to react exothermically with the tape to form a hard, durable, airtight seal.
- D. Solvent-Based Joint and Seam Sealant: One-part, non-sag, solvent-release-curing, polymerized butyl sealant complying with FS TT-S-001657, Type I; formulated with a minimum of 70 percent solids.
 1. Manufacturers:

- a. Childers CP-140.
 - b. Duro Dyne SGD.
 - c. Fosters 32-14.
 - d. Approved equal.
- E. Water-Based Joint and Seam Sealant, Non-Fibrated: UL 181 listed. Sealant shall be rated to ± 15 inches w.g. Sealant shall have a service temperature of -25 to 200 F and be freeze/thaw stable through 5 cycles.
- 1. Manufacturers:
 - a. Childers CP-146.
 - b. Design Polymerics DP 1010.
 - c. Ductmate Proseal/Fiberseal.
 - d. Duro Dyne Duroseal.
 - e. Fosters 32-19
 - f. United Duct Sealer (Water Based).
 - g. Hardcast 601.
- F. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- G. Flanged Gasket Tapes: Butyl gasket shall be UL 181 classified. Gasket size shall be minimum $5/8$ inch x $3/16$ inch and have nominal 100 percent solid content. It shall be non-oxidizing, non-skinning and have a service temperature of -25 to 180 F.
- 1. Manufacturers:
 - a. Design Polymerics DP 1040.
 - b. Ductmate 440.
 - c. Hardcast 1104.

2.4 HANGERS AND SUPPORTS

- A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concrete or for slabs less than 4 inches thick.
- B. Hangers: Galvanized sheet steel, or round, uncoated steel, threaded rod.
 - 1. Hangers Installed In Corrosive Atmospheres: Electro-galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.
 - 2. Straps and Rod Sizes: Conform with SMACNA HVAC Duct Construction Standards, 2005 Edition, for sheet steel width and gauge and steel rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36.
 - 1. Where galvanized steel ducts are installed, provide hot-dipped-galvanized steel shapes and plates.
 - 2. For stainless steel ducts, provide stainless steel support materials.

3. For aluminum ducts, provide aluminum support materials, except where materials are electrolytically separated from ductwork.

E. Wire Rope Hanging Systems:

1. Manufacturers:
 - a. Anvil International.
 - b. Ductmate Industries, Inc; Clutcher Cable Hanging System.
 - c. Duro Dyne.
 - d. Gripple.
2. General: Wire rope hanger system shall have a minimum 5 to 1 safety factor based upon the applied working load being supported.
3. Source Limitations: Furnish associated fittings, accessories, and hardware produced by a single manufacturer.
4. Wire Rope: Zinc coated or galvanized steel, with wire thread type as required to support the applied working load being supported. Provide same size wire for all applications based on worst case loading.
5. Cable Lock: Cast zinc housing with steel spring with wedge grip, selected to meet the vertical load applied to the hanging system and wire thread. Do not exceed the working load limit.
6. Accessories: Hanger attachments and structural attachments shall be compatible with wire rope hanger system and shall be by the same manufacturer as the wire rope hanger system.

2.5 RECTANGULAR DUCT FABRICATION

- A. General: Except as otherwise indicated, fabricate rectangular ducts with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Tables 2-1 through 2-28, including their associated details. Conform to the requirements in the referenced standard for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.
 1. Fabricate rectangular ductwork of minimum 26 gauge sheet metal.
 2. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
 3. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.
- B. Crossbreaking or Cross Beading: Crossbreak or bead duct sides that are 19 inches and larger and are 20 gauge or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 2-9, unless they are lined or are externally insulated.
- C. Exterior Ductwork: Ductwork installed exterior to the building without weather-proof jacket or cladding shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".

2.6 RECTANGULAR DUCT FITTINGS

- A. Fabricate elbows, transitions, offsets, branch connections, and other duct construction in accordance with SMACNA "HVAC Metal Duct Construction Standard," 2005 Edition, Figures 4-1 through 4-8. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper, 3/8 inch square shaft, U-bolt, nylon bushings, locking quadrant, and 2 inch insulation build-out for branch duct connections and take-offs to individual diffusers, registers and grilles. 45 degree, high

efficiency, rectangular/round branch duct takeoff fittings shall be Flexmaster STO with model BO3 damper or equal.

- B. Provide radius elbows, turns, and offsets with a minimum centerline radius of 1-1/2 times the duct width. Where space does not permit full radius elbows, provide short radius elbows with a minimum of two continuous splitter vanes. Vanes shall be the entire length of the bend. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
- C. Provide mitered elbows where space does not permit radius elbows, where shown on the drawings, or at the option of the contractor with the engineer's approval. The contractor shall obtain approval to substitute mitered elbows in lieu of radius elbows prior to fitting fabrication. Mitered elbows less than 45 degrees shall not require turning vanes. Mitered elbows 45-degrees and greater shall have single thickness turning vanes of same material and gauge as ductwork, rigidly fastened with guide strips in ductwork. Vanes for mitered elbows shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork. Refer to Section "Ductwork Accessories" for turning vane construction and mounting.
- D. Provide full radius elbows for ductwork installed in noise critical spaces. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces. Where space does not permit the installation of radius elbows, provide mitered elbows with sound attenuating, acoustical turning vanes. Refer to Section "Ductwork Accessories" for acoustical turning vanes.

2.7 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS

- A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness is prohibited.
- B. Apply a coat of adhesive to liner facing in direction of airflow not receiving metal nosing.
- C. Butt transverse joints without gaps and coat joint with adhesive.
- D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.
- E. Longitudinal joints in rectangular ducts shall not occur except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.
 - 1. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.
- F. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely around perimeter; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- G. Secure transversely oriented liner edges facing the airstream with metal nosings that are either channel or "Z" profile or are integrally formed from the duct wall at the following locations:
 - 1. Fan discharge.
 - 2. Intervals of lined duct preceding unlined duct.
 - 3. Upstream edges of transverse joints in ducts where duct velocity is greater than 2,500 FPM.
- H. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve through fire separation.

2.8 ROUND AND FLAT OVAL DUCT FABRICATION

- A. General: "Basic Round Diameter" as used in this article is the diameter of the size of round duct that has a circumference equal to the perimeter of a given sized of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
 - 1. Fabricate round and flat oval ductwork of minimum 26 gauge sheet metal.
- B. Round Ducts: Fabricate round supply ducts using seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-1, RL-4, or RL-5 except where diameters exceed 72 inches. Seam Types RL-2 or RL-3 may be used for ducts smaller than 72 inches in diameter if spot-welded on 1-inch intervals. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-5 through 3-13 for galvanized steel gauges. For round duct with static pressure classification of 2 inches water gauge or lower, round supply ducts may be fabricated using snaplock seam types identified in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 3-2, RL-6A, RL-6B, RL-7 or RL-8.
- C. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gauges listed in SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-15.
- D. Double-Wall (Insulated) Ducts: Fabricate double-wall insulated ducts with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.
 - 1. Outer Shell: Base outer shell gauge on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation, and in gauges specified above for single-wall duct.
 - 2. Insulation: Meet the performance criteria as specified in paragraph "Duct Liner" above. Provide insulation ends where internally insulated duct connects to single-wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the inner liner diameter.
 - 3. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gauges listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
 - 4. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gauges listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated below is the "basic round diameter."
 - a. 3 to 8 inches: 28 gauge with standard spiral construction.
 - b. 9 to 42 inches: 28 gauge with single-rib spiral construction.
 - c. 44 to 60 inches: 26 gauge with single-rib spiral construction.
 - d. 62 to 88 inches: 22 gauge with standard spiral construction.
 - 5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.
- E. Field Painted Ductwork: All round and flat oval ductwork and duct fittings to be field painted shall have galvanized metal primer applied in the shop after fabrication and prior to shipping.

2.9 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

- A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 3-5, 3-6 and 3-7 and with metal thickness specified for longitudinal seam straight duct.
- B. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.
- C. Elbows: Unless elbow construction type is indicated, provide elbows meeting the following requirements:
 - 1. Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter.
 - a. Elbows in Round Duct: Provide full radius elbows.
 - b. Elbows in Flat Oval Duct: Provide full radius elbows. Where space limits the installation of full radius elbows, short radius elbows with a minimum of two continuous splitter vanes shall be installed. Vane length shall be the entire length of the bend or 36 inches whichever is greater.
 - c. The use of square throat, radius heel elbows is prohibited. Remove and replace all installed elbows of this type with an approved elbow at no additional cost to the owner.
 - d. Provide full radius elbows for ductwork installed in noise critical spaces or where shown on the drawings. Refer to Section "Basic Mechanical Materials and Methods" for noise critical spaces.
 - 2. Mitered Elbows: Fabricate mitered elbows with welded construction in gauges specified below.
 - a. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Table 3-1.
 - b. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
 - 1) 3 to 26 inches: 24 gauge.
 - 2) 27 to 36 inches: 22 gauge.
 - 3) 37 to 50 inches: 20 gauge.
 - 4) 52 to 60 inches: 18 gauge.
 - 5) 62 to 84 inches: 16 gauge.
 - c. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
 - 1) 3 to 14 inches: 24 gauge.
 - 2) 15 to 26 inches: 22 gauge.
 - 3) 27 to 50 inches: 20 gauge.
 - 4) 52 to 60 inches: 18 gauge.
 - 5) 62 to 84 inches: 16 gauge.
 - d. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.

- e. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems, or exhaust systems for material handling classes A and B; and only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with a single-thickness turning vane.
- 3. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.
- 4. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 9-1/2- and 10-1/2-inch) elbows with gored construction.
- 5. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.
- 6. Die-Formed Elbows for Sizes Through 8 Inches and All Pressures: 20 gauge with 2-piece welded construction.
- 7. Round Gored Elbows Gauges: Same as for non-elbow fittings specified above.
- 8. Flat Oval Elbows Gauges: Same as longitudinal seam flat oval duct.
- 9. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 26 gauge.
- D. Double-Wall (Insulated) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation, and an inner liner as specified below. Dimensions indicated on internally insulated ducts are nominal inside dimensions.
 - 1. Outer Shell: Base outer shell gauge on actual outer shell dimensions. Provide outer shell lengths 2 inches longer than inner shell and insulation. Gauges for outer shell shall be same as for uninsulated fittings specified above.
 - 2. Insulation: Unless otherwise indicated, provide 1-inch-thick fiber-glass insulation with thermal conductivity performance of 0.27 Btu/sq.ft./°F/inch-thickness at 75°F mean temperature. Provide insulation ends where internally insulated duct connects to single-wall duct or non-insulated components. The insulation end shall terminate the insulation and reduce the outer shell diameter to the nominal single-wall size.
 - 3. Solid Inner Liner: Construct round and flat oval inner liners with solid sheet metal of the gauges listed below. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
 - 4. Perforated Inner Liner: Construct round and flat oval inner liners with perforated sheet metal of the gauges listed below. Provide 3/32-inch-diameter perforations, with an overall open area of 23 percent. For flat oval ducts, the diameter indicated in the table below is the "basic round diameter."
 - a. 3 to 34 inches: 24 gauge.
 - b. 35 to 58 inches: 22 gauge.
 - c. 60 to 88 inches: 20 gauge.
 - 5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.10 FACTORY-MANUFACTURED DUCTWORK

- A. Manufacturers:
 - 1. Hercules Industries.

2. Lewis & Lambert.
 3. Lindab Safe.
 4. Linx Industries, Inc.
 5. Semco.
 6. Approved equal.
- B. General: At the Contractor's option, factory-manufactured ductwork can be provided instead of fabricated ductwork for round and oval ductwork. The round duct system shall consist of fittings that are factory fitted with a sealing gasket and spiral duct which, when installed according to the manufacturer's instructions, will seal the duct joints without the use of duct sealer.
- C. Duct Construction
1. Unless otherwise noted, all duct and fittings shall be constructed from galvanized steel in accordance with SMACNA's Duct Construction Standards for +10" water gauge pressure with thickness as shown in the following tables:

Single Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct	Galvanized Fittings
3-14	28	24
15-24	26	24
26-42	24	22
42-60	22	20

Double Wall Round Duct:

Diameter (Inches)	Galvanized Spiral Duct		Galvanized Fittings	
	Inner	Outer	Inner	Outer
3-14	28	28	24	24
16-24	26	26	24	24
26-42	24	24	22	22
44-60	22	22	20	20

Oval Duct:

Major Axis (Inches)	Galvanized Spiral Duct (ga)	Galvanized Fittings (ga)
3-24	24	20
25-38	22	20
37-48	22	18
49-60	20	18
61-70	20	16
71 and large	18	16

2. Duct shall be calibrated to manufacturer's published dimensional tolerance standard.
3. All duct 14" diameter and larger shall be corrugated for added strength and rigidity.
4. Spiral seam slippage shall be prevented by means of a flat seam and a mechanically formed indentation evenly spaced along the spiral seam.

5. Ducts shall be constructed using spiral lock seam sheet metal construction.
6. Ductwork to be installed in exposed locations shall have the surface prepared in the factory for field painting.

D. Fittings:

1. All fitting ends for round duct and transitions and divided flow fittings smaller than 50" diameter that convert oval duct to round duct shall come factory equipped with a double lipped, U-profile, EPDM rubber gasket. Gasket shall be manufactured to gauge and flexibility so as to insure that system will meet all of the performance criteria set forth in the manufacturer's literature. Gasket shall be classified by Underwriter's Laboratories to conform to ASTM E84-91a and NFPA 90A flame spread and smoke developed ratings of 25/50.
2. All fittings shall be calibrated to manufacturer's published dimensional tolerance standard and associated spiral duct.
3. All fitting ends from 5" to 60" diameter shall have rolled over edges for added strength and rigidity.
4. All elbows from 5" to 12" diameter shall be 2 piece die stamped and continuously stitch welded. All elbows 14" diameter and larger shall be standing seam gorelock construction and internally sealed.
5. The radius of all 90° and 45° elbows shall be 1.5 times the elbow diameter, unless otherwise noted on the contract documents to be 1.0. The radius of all 15°, 30° and 60° elbows shall be 1.0 times the elbow diameter.
6. All fittings that are of either spot welded or button punched construction shall be internally sealed. When contract documents require divided flow fittings, only full body fittings will be accepted. The use of duct taps is unacceptable except for retrofit installations.
7. Double wall duct and fittings shall consist of a perforated or solid inner liner, a 1 inch, 1.50 lb/ft³ (unless otherwise specified) layer of fiberglass insulation and a solid outer pressure shell. Perforated inner liner shall have a retaining fabric wrapped between the perforated inner and the fiberglass insulation. This fabric shall provide fiberglass tear retention while maintaining the desired acoustical properties. For 1 inch thick insulation, the outer pressure shell diameter shall be 2 inches larger than the inner liner.
8. All double wall fittings for round duct shall be furnished with the Lindab Safe gasket on the outer shell. The inner shell on all double wall fittings shall extend a minimum of 1 inch past the outer shell.
9. Double wall to single wall transitions shall be provided where insulated duct connects to non-insulated, single wall duct. Transitions shall also act as insulation ends reducing the double wall outer shell diameter to the inner shell diameter.
10. All double wall duct and fittings shall be furnished with both an inner liner and an outer pressure shell coupling. The inner liners shall not be fastened tighter to allow for expansion and contraction.
11. All volume dampers shall be Lindab Safe type DRU, DSU or DTU or approved equal. Damper shall be fitting sized to slip into spiral duct. Damper shall have the following features:
 - a. Locking quadrant with blade position indicator.
 - b. 2" sheet metal insulation stand-off.
 - c. Integral shaft/blade assembly.
 - d. Shaft mounted, load bearing bushings.

- e. Gasketed shaft penetrations to minimize leakage.

PART 3 - EXECUTION

3.1 DUCT MATERIAL APPLICATION

- A. All ducts shall be galvanized steel.
 - 1. Exterior Ductwork: Ductwork installed exterior to the building shall be minimum #18 gauge with longitudinal and transverse joints welded or sealed airtight as specified under Paragraph "Seam and Joint Sealing".

3.2 DUCT LINER INSTALLATION

- A. Fiberglass Duct Liner:
 - 1. Attach fiberglass duct liner using fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
- B. Application: Provide duct liner on the following interior air ducts and where specified on the drawings.
 - 1. Supply Ductwork:
 - a. First 15 feet of ductwork downstream of equipment outlets.
 - 2. Return Ductwork.
 - a. First 15 feet of ductwork upstream of equipment outlets.

3.3 DUCT INSTALLATION, GENERAL

- A. Install products in accordance with manufacturer's instructions.
- B. Duct System Pressure Class: Construct and install each duct system except factory-manufactured ductwork for the specific duct pressure classification indicated. For factory-manufactured ductwork, refer to Paragraph "Factory-Manufactured Ductwork".
 - 1. Supply Air Ducts: 3 inches water gauge.
 - 2. Primary Supply Air Ducts (upstream of terminal boxes): 4 inches water gauge.
 - 3. Secondary Supply Air Ducts (downstream of terminal boxes): 2 inches water gauge
 - 4. Return and Outdoor Air Ducts: 2 inches water gauge, negative pressure.
 - 5. Exhaust Air Ducts: 2 inches water gauge, negative pressure.
- C. Install ducts with the fewest possible joints.
- D. Seal duct joints with the appropriate sealing material.
- E. Use fabricated fittings for all changes in directions, changes in size and shape, and connections.
- F. Install couplings tight to duct wall surface with projections into duct at connections kept to a minimum.
- G. Locate ducts, except as otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs. Install duct systems in shortest route that does not obstruct useable space or block access for servicing building and its equipment.
- H. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

- I. Cover ducts openings during construction with duct caps or three-mil plastic to protect inside of (installed and delivered) ductwork from exposure to dust, dirt, paint and moisture. Do not use duct tape on ducts that will be exposed or painted.
- J. Provide clearance of 1 inch where furring is shown for enclosure or concealment of ducts, plus allowance for insulation thickness, if any.
- K. Install insulated ducts with 1-inch clearance outside of insulation.
- L. Conceal ducts from view in finished and occupied spaces by locating in mechanical shafts, hollow wall construction, or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown.
- M. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- N. Exposed Ductwork: Exposed ductwork shall be free of defects, dents or blemished surfaces to provide a smooth, finished appearance. Any damaged material shall be replaced with new material. Ductwork that is to be field painted shall have surfaces wiped clean of lubricant, dirt, or fil prior to priming and painting. Apply primer and paint of type as recommended by paint manufacturer for duct material and finish.
- O. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
- P. Non-Fire-Rated Partition Penetrations: Where ducts pass interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gauge as duct. Overlap opening on 4 sides by at least 1-1/2 inches.

3.4 SEAM AND JOINT SEALING

- A. General: Seal duct seams and joints as follows:
 - 1. All transverse joints, longitudinal seams, and duct wall penetrations shall be sealed to meet SMACNA Seal Class A.
 - 2. Seal class shall apply to all supply, return, outdoor air, and exhaust ductwork, regardless if the duct is positively or negatively pressurized.
- B. Seal externally insulated ducts prior to insulation installation.
- C. Ductwork installed exterior to the building shall have longitudinal and transverse joints welded or sealed airtight with weatherproof heavy liquid sealant applied according to manufacturer's instructions.

3.5 HANGING AND SUPPORTING

- A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in Chapter 5 of the SMACNA "HVAC Duct Construction Standards", 2005 Edition.
- B. Installation of Wire Roper Hanger Systems:
 - 1. Install in accordance with manufacturer's instructions.
 - 2. Wire rope hanger spacing shall not exceed 8 feet. Supported load shall not exceed manufacturer's recommended load rating.
 - 3. Where approved by local code authority, the loop system may be swaged directly on to a seismic approved bracket or appropriate end fixing.
- C. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.
- D. Support vertical ducts at a maximum interval of 16 feet and at each floor.

- E. Upper attachments to structures shall have an allowable load not exceeding 1/4 of the failure (proof test) load but are not limited to the specific methods indicated. Hangers and supports shall be fastened to building joists or beams. Do not attach hangers and supports to the above floor slab or roof with sheet metal screws.
- F. Install concrete insert prior to placing concrete.
- G. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.6 PENETRATIONS

- A. Fire Barrier Penetrations: Where ducts pass through fire-rated walls, partitions, ceilings, and floors, maintain the fire-rated integrity.
- B. Exterior Wall Penetrations: Seal duct penetrations through exterior wall constructions with sleeves, packing, and sealant. Refer to Division 23 Section "Basic Mechanical Materials and Methods" for additional information.

3.7 CONNECTIONS

- A. Equipment Connections: Connect equipment with flexible connectors in accordance with Division 23 Section "Air Duct Accessories."
- B. Branch Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 4-5 and 4-6.
- C. Outlet and Inlet Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figures 7-6 and 7-7. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 Section "Air Duct Accessories."
- D. Fan Connections: Comply with SMACNA "HVAC Duct Construction Standards," 2005 Edition, Figure 7-8.

3.8 FIELD QUALITY CONTROL

- A. Remove temporary protection devices over ductwork prior to starting equipment and turning the system over to the owner.
- B. If permanent HVAC equipment is used during the construction period, provide temporary filters at all openings in the ductwork and at inside equipment to protect the system from dust, dirt, paint, and moisture. Replace and maintain filters when needed, but not less than every month. On the day of substantial completion, clean the duct system and provide a new set of filters in the HVAC unit.
 - 1. Refer to Division 23 Section 234100 Particulate Air Filtration for filter requirements.

3.9 ADJUSTING AND CLEANING

- A. Adjust volume control devices as required by the testing and balancing procedures to achieve required air flow. Refer to Division 23 Section "TESTING, ADJUSTING, AND BALANCING FOR HVAC" for requirements and procedures for adjusting and balancing air systems.
- B. Vacuum duct systems prior to final acceptance to remove dust and debris.

3.10 CLEANING NEW SYSTEMS

- A. Contractor shall clean the HVAC systems in accordance with NADCA.
- B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.
- C. Use service openings, as required, for physical and mechanical entry and for inspection.
 - 1. Create other openings to comply with duct standards.

- a. Do not degrade structural, thermal or functional system integrity of the duct.
 - b. Provide access doors complying with UL 181 to cover new openings. Refer to Division 23 Section "Air Duct Accessories".
 - c. Seal openings with tape and sealant complying with UL 181A.
2. Disconnect flexible ducts as needed for cleaning and inspection.
 3. Remove and reinstall ceiling sections to gain access during the cleaning process.
- D. Vent vacuuming system to the outside. Provide filtration and/or containment systems to keep debris removed from HVAC systems from contaminating other spaces. Locate exhaust down wind and away from air intakes and other points of entry into building.
- E. Clean the following metal duct systems by removing surface contaminants and deposits:
1. Air outlets and inlets (registers, grilles, and diffusers).
 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 4. Coils and related components.
 5. Return air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
 6. Supply and outdoor air ducts, dampers, actuators, and turning vanes.
- F. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment while the system is under negative pressure; do not permit duct liner to get wet.
 5. Clean coils and coil drain pans according to ACR 2002. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- G. Disposal: Debris collected from the HVAC system shall be disposed of in accordance with applicable federal, state and local requirements.
- H. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
 2. Where contaminants are discovered, re-clean and re-inspect ducts.

END OF SECTION

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this Section.
- B. Types of ductwork accessories required for project include the following:
 - 1. Dampers.
 - a. Low pressure manual dampers.
 - 2. Turning vanes.
 - 3. Duct hardware.
 - 4. Duct access doors.
 - 5. Metal duct connectors.
 - 6. Flexible duct connectors.
- C. Refer to other Division 23 Sections for testing, adjusting, and balancing of ductwork accessories; not work of this Section.

1.2 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductwork accessories, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Codes and Standards:
 - 1. SMACNA Compliance: Comply with applicable portions of SMACNA "HVAC Duct Construction Standards, Metal and Flexible", 2005 Edition.
 - 2. Industry Standards: Comply with ASHRAE recommendations pertaining to construction of ductwork accessories, except as otherwise indicated.
 - 3. UL Compliance:
 - a. Construct flexible ductwork in compliance with UL Standard 181 "Factory-Made Air Ducts and Connections".
 - b. Duct tape shall be labeled in accordance with UL Standard 181B and marked 181B-FX.
 - c. Duct clamps shall be labeled in accordance with UL Standard 181B and marked 181B-C.
 - 4. NFPA Compliance:
 - a. Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems", pertaining to installation of ductwork accessories. Comply with NFPA 90B "Standard for the Installation of Warm Air Heating and Air-Conditioning Systems.
 - 5. ASTM Compliance: Products shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 "Surface Burning Characteristics" (NFPA 255) method.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each type of ductwork accessory including dimensions, capacities and materials of construction; and installation instructions. Submit performance data for duct silencers including insertion loss performance in octave bands from 63 Hz to 8,000 Hz and pressure drop at specified airflow.

- B. Shop Drawings: Submit manufacturer's assembly-type shop drawings for each type of ductwork accessory showing interfacing requirements with ductwork, method of fastening or support, and methods of assembly of components.
- C. Maintenance Data: Submit manufacturer's maintenance data including parts lists for each type of duct accessory. Include this data, product data, and shop drawings in maintenance manual; in accordance with requirements of Division 1.

PART 2 - PRODUCTS AND MATERIALS

2.1 DAMPERS

- A. Low Pressure Manual Dampers: Provide dampers of single blade type or multi-blade type, constructed in accordance with SMACNA "HVAC Duct Construction Standards".
 - 1. Material: Galvanized steel for standard air systems, aluminum for wet or natatorium environments and stainless steel for corrosive environments.
 - 2. Construction: Bearings shall be corrosion resistant, molded synthetic and axles shall positively lock into the damper blade. Extended shafts and standoff bracket for insulation clearance shall be metal material. Provide with locking quadrant.
 - 3. Blade Seals: Where dampers are used for shutoff duty, provide Neoprene seals for round dampers and silicone for rectangular dampers.
 - 4. Dampers shall be Greenheck Model MBD Series, or approved equal.
- B. Manufacturer: Subject to compliance with requirements, provide dampers of one of the following:
 - 1. Air Balance, Inc.
 - 2. Arrow United Industries.
 - 3. Cesco
 - 4. Greenheck
 - 5. Louvers & Dampers, Inc.
 - 6. Nailor Industries, Inc.
 - 7. Pottorff
 - 8. Ruskin Mfg. Co.
 - 9. TAMCO
 - 10. Vent Products

2.2 TURNING VANES

- A. Manufactured Turning Vanes: Provide turning vanes and runners fabricated from galvanized sheet metal, lock-forming quality, ASTM A 653, minimum Coating Designation G 60, of the same gauge thickness or greater as the ductwork in which they are installed. Vanes shall be rigidly fastened with guide strips to minimize noise and vibration. Vanes in ductwork over 30" deep shall be installed in multiple sections with vanes not over 30" long and shall be rigidly fastened. Turning vanes shall be constructed per SMACNA Duct Construction Standards Metal and Flexible – 2005 Edition, Figure 4-3 and set into side strips suitable for mounting in ductwork.
- B. Acoustical Turning Vanes: Provide acoustical turning vanes constructed of airfoil shaped aluminum extrusion with perforated faces and fiberglass fill in systems serving noise critical spaces. Refer to Section "Common Work Results for HVAC".
- C. Manufacturer: Subject to compliance with requirements, provide turning vanes of one of the following:
 - 1. Aero Dyne Co.
 - 2. Anemostat Products Div.; Dynamics Corp. of America.
 - 3. Ductmate Industries.

4. Duro Dyne Corp.
5. Elgen Manufacturing Co., Inc.
6. Hart & Cooley Mfg. Co.
7. Register & Grille Mfg. Co., Inc.
8. Sheet Metal Connectors, Inc.

2.3 DUCT HARDWARE

- A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:
 1. Test Holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
 2. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.
- B. Manufacturer: Subject to compliance with requirements, provide duct hardware of one of the following:
 1. Ductmate Industries.
 2. Elgen Manufacturing Co., Inc.
 3. Ventfabrics, Inc.
 4. Young Regulator Co.

2.4 DUCT ACCESS DOORS

- A. General: Provide, where indicated on the drawings or where specified in Part 3 of this section, duct access doors of size allowable by duct dimensions with, unless otherwise noted on the drawings, minimum size of 10" by 10" and maximum size of 24" by 24". Provide removable section of duct where duct size is too small for a 10" by 10" access door. Construct access doors in accordance with SMACNA "HVAC Duct Construction Standards – Metal and Flexible" and as specified herein. Label access doors for fire and smoke dampers as specified in Paragraph "Installation of Ductwork Accessories.
- B. Construction: Construct of same or greater gage as ductwork served, provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one size hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.
- C. Manufacturer: Subject to compliance with requirements, provide duct access doors of one of the following:
 1. Air Balance Inc.
 2. Ductmate Industries.
 3. Duro Dyne Corp.
 4. Greenheck.
 5. Register & Grille Mfg. Co., Inc.
 6. Ruskin Mfg. Co.
 7. Ventifabrics, Inc.
 8. Vent Products.
 9. Zurn Industries, Inc.; Air Systems Div.

2.5 METAL DUCT CONNECTORS

- A. Description: Factory-fabricated, slide-on transverse flange connectors, corners, cleats, gaskets, and components. Material, gauge, and shape shall match the connecting ductwork.

B. Manufacturers: Subject to compliance with requirements, provide duct connectors by one of the following or approved equal:

1. Ductmate Industries.
2. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.6 FLEXIBLE DUCT CONNECTORS

A. Fabric Material: Flame-retardant or noncombustible fabrics compliant with NFPA 701.

1. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of minimum 24 gauge galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
2. Indoor System, Flexible Connector Fabric: Glass fabric coated with neoprene.
 - a. Minimum Weight: 26 oz./sq. yd.
 - b. Minimum Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - c. Service Temperature: Minus 40 to plus 200 deg F.
3. Outdoor System, Flexible Connector Fabric: Glass fabric coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - a. Minimum Weight: 24 oz./sq. yd.
 - b. Minimum Tensile Strength: 225 lbf/inch in the warp and 300 lbf/inch in the filling.
 - c. Service Temperature: Minus 40 to plus 250 deg F.

B. Coatings and Adhesives: Comply with UL 181, Class 1.

C. Flexible connectors shall have flame-spread index of 25 or less, and smoke-developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

D. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:

1. Ductmate Industries.
2. Duro Dyne Corp.
3. Elgen Manufacturing Co., Inc.
4. Ventfabrics, Inc.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF DUCTWORK ACCESSORIES

- A. Install ductwork accessories in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Provide balancing dampers at branch takeoffs from main ducts. Unless otherwise noted on drawings, provide prefabricated 45 degree, high efficiency, rectangular/round branch duct takeoff fittings with manual balancing damper and locking quadrant for branch duct connections and takeoffs to individual diffusers, registers and grilles.
- C. Provide turning vanes, of same gauge as ductwork, rigidly fastened with guide strips in ductwork having an offset of 45 degrees or more. Vanes shall be provided in all supply and exhaust ductwork and in return and outside air ductwork that has an air velocity exceeding 1000 fpm. Do not install vanes in grease ductwork.

- D. Provide duct access doors to maintain and/or clean components internal to ductwork including, but not limited to, coils, airflow stations, motorized and backdraft dampers, humidifiers, etc, and equipment at the following locations: Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
 - 1. At each change in direction and at maximum 50-foot (15-m) spacing.
 - 2. Upstream from turning vanes.
 - 3. Upstream or downstream from duct silencers.
- E. Provide duct access door(s) as scheduled below, at each fire and smoke damper within 12 inches of the device to allow for testing and maintenance. Label each door (with minimum 1" lettering) indicating which damper type is served. Door should be capable of being fully opened or provide removable door.

DUCT ACCESS DOOR SCHEDULE

Duct Width/Depth	Door Size	Quantity
10" TO 12"	10 X 10	1
14" TO 18"	12 X 12	1
20" TO 36"	14 X 14	1
38" TO 54"	18 X 18	1
56" TO 72"	18 X 18	2 (1 EACH END)
74" TO 96"	20 X 20	2 (1 EACH END)

- F. Provide flexible duct connections wherever ductwork connects to vibrating equipment and when transitioning between two different metallic duct materials (e.g., aluminum to galvanized steel). Construct flexible connections of fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.

3.3 FIELD QUALITY CONTROL

- A. Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories, as required to obtain proper operation and leakproof performance.

3.4 ADJUSTING AND CLEANING

- A. Adjusting: Adjust ductwork accessories for proper settings, install fusible links in fire dampers and adjust for proper action.
- B. Label access doors in accordance with Division-23 section "Identification for HVAC Piping and Equipment".
- C. Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing for HVAC".
- D. Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION

SECTION 233413

AXIAL HVAC FANS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes the following types of axial fans:

1. High Volume Low Speed (HVLS) fans.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 01 Specification Sections:

1. Product data for selected models, including specialties, accessories, and the following:
 - a. Certified fan performance curves with system operating conditions indicated.
 - b. Certified fan sound power ratings.
 - c. Motor ratings and electrical characteristics plus motor and fan accessories. For fans with factory-furnished starters or variable frequency drives, include short circuit current ratings.
 - d. Materials gages and finishes, including color charts.
 - e. Dampers, including housings, linkages, and operators.
2. Shop drawings from manufacturer detailing equipment assemblies and indicating dimensions, weights, required clearances, components, and location and size of field connections.
3. Wiring diagrams that detail power, signal, and control wiring. Differentiate between manufacturer-installed wiring and field-installed wiring.
4. Maintenance data for axial fans, for inclusion in Operating and Maintenance Manual specified in Division 01 and Division 23 Section "General Mechanical Requirements."

1.3 QUALITY ASSURANCE

A. AMCA Compliance:

1. Provide HVLS fans that are tested and labeled in accordance with AMCA 230.

B. UL Compliance: Fans and components shall be UL listed and labeled.

C. Nationally Recognized Testing Laboratory and NEMA Compliance (NRTL): Fans and components shall be NRTL listed and labeled. The term "NRTL" shall be as defined in OSHA Regulation 1910.7.

D. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

E. Electrical Component Standard: Components and installation shall comply with NFPA 70 "National Electrical Code."

1.4 SEQUENCING AND SCHEDULING

A. Coordinate the size and location of structural steel support members.

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. HVLS Fans:

- a. Big Ass Fans.
- b. Greenheck.
- c. Macro Air Technology
- d. SkyBlade

2.2 SOURCE QUALITY CONTROL

- A. Testing Requirements: The following factory tests are required for propeller, tubeaxial, mixed flow and vaneaxial fans:
 1. Sound Power Level Ratings: Comply with AMCA Standard 301 "Method for Calculating Fan Sound Ratings From Laboratory Test Data." Test fans in accordance with AMCA Standard 300 "Test Code for Sound Rating." Fans shall be licensed to bear the AMCA Certified Sound Ratings Seal.
 2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA Standard 210/ASHRAE Standard 51 - Laboratory Methods of Testing Fans for Rating.

2.3 FANS, GENERAL

- A. General: Provide fans that are factory fabricated and assembled, factory tested, and factory finished with indicated capacities and characteristics.
- B. Fans and Shafts: Statically and dynamically balanced and designed for continuous operation at the maximum rated fan speed and motor horsepower.
 1. Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fan's class.
- C. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.
- D. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15 HP; fixed pitch for use with motors larger than 15 HP. Select pulley so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 1. Belt Guards: Provide steel belt guards for motors mounted on the outside of the fan cabinet.
- E. Shaft Bearings: Provide type indicated, having a median life "Rating Life" (AFBMA L(50)) of 200,000, calculated in accordance with AFBMA Standard 9 for ball bearings and AFBMA Standard 11 for roller bearings.
- F. Factory Finish: The following finishes are required:
 1. Sheet Metal Parts: Prime coating prior to final assembly.
 2. Exterior Surfaces: Baked-enamel finish coat after assembly.

2.4 HVLS FANS

- A. General Description: Propeller-type fans 6 feet in diameter and larger consisting of fan blades, hub, mounting system, bevel gear reducer drive, motor, and fan controller.
 1. Acceptable alternate to bevel gear reducer drive, motor and VFD as specified herein is a gearless, direct drive fan to motor connection and radial flux, permanent magnet AC motor as furnished by MacroAir.
- B. Fan Blades: Aluminum alloy, airfoil design.
- C. Hub: Cast aluminum alloy incorporating 1/4" or greater steel safety clips to restrain the hub/airfoil assembly in case of shaft failure.
- D. Bevel Gear Reducer: High efficiency, helical gear reducer with a cast iron housing, designed for low noise and long service life with a backlash of less than 20 arc-minutes. Output shaft shall be stainless steel. Gear reducer shall be permanently lubricated and be assembled with double lip seals to prevent contamination or oil leakage.

- E. Motor and Frame: 1750 RPM, 208-230/460 VAC, 60 Hz, 3 phase, inverter rated with class F insulation, 40 degrees C Ambient-Continuous. Provide HP as scheduled or as applicable. Motor frame and mount shall be constructed of minimum 3/16" powder-coated steel.
- F. Mounting System: Designed for secure mounting of fan from overhead support structure with extension rod. Mount shall be constructed of minimum 3/16" powder-coated steel. Provide minimum 1/4" 7x19 steel safety cable to secure fan assembly to structure.
- G. Fan Controller:
 - 1. Auxiliary contacts to shutdown fan upon notification from fire alarm system.
 - 2. Industrial Control Panel constructed per UL 508A and NEC.
 - 3. Factory programmed Variable Frequency Drive (VFD) for soft start and infinite speed control.
 - 4. Size VFD for motor full load amp rating.
 - 5. Provide overload relay for each motor when VFD controls multiple fans.
 - 6. Provide load reactors for 460 VAC multi-fan control.
 - 7. Provide fan on/off/auto switch, speed control potentiometer, safety disconnect and properly sized fuse block.
 - 8. Provide NEMA Type 1 controls enclosure.

2.5 MOTORS

- A. Torque Characteristics: Sufficient to accelerate the driven loads satisfactorily.
- B. Motor Sizes: Minimum sizes and electrical characteristics as indicated. If not indicated, large enough so that the driven load will not require the motor to operate in the service factor range.
- C. Temperature Rating: 90 deg C maximum temperature rise at 40 deg C ambient for continuous duty at full load (Class B Insulation).
- D. Service Factor: 1.15 for polyphase motors and 1.35 for single-phase motors.
- E. Motor Construction: NEMA Standard MG 1, general purpose, continuous duty, Design B. Provide permanent-split capacitor classification motors for shaft-mounted fans and capacitor start classification for belted fans.
 - 1. Bases: Adjustable.
 - 2. Bearings: The following features are required:
 - a. Ball or roller bearings with inner and outer shaft seals.
 - b. Grease lubricated.
 - c. Designed to resist thrust loading where belt drives or other drives produce lateral or axial thrust in motor.
 - 3. Enclosure Type: The following features are required:
 - a. Open drip-proof motors where satisfactorily housed or remotely located during operation.
 - b. Guarded drip-proof motors where exposed to contact by employees or building occupants.
 - 4. Overload protection: Built-in, automatic reset, thermal overload protection.
 - 5. Noise rating: Quiet.
 - 6. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled in accordance with IEEE Standard 112, Test Method B. If efficiency not specified, motors shall have a higher efficiency than "average standard industry motors" in accordance with IEEE Standard 112, Test Method B.
 - 7. Nameplate: Indicate the full identification of manufacturer, ratings, characteristics, construction, and special features.

- F. Starters, Electrical Devices, and Wiring: Starters, electrical devices and connections are specified in Division 26.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install fans level and plumb, in accordance with manufacturer's written instructions.
1. Suspended Units: Suspend units from structural steel support frame using threaded steel rods and vibration isolation as recommended by the manufacturer.
- B. Arrange installation to provide access space around fans for service and maintenance.

3.2 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust damper linkages for proper damper operation.
- B. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel and cabinet.

3.3 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
1. Remove shipping blocking and bracing.
 2. Verify fan assembly is secure on mountings and supporting devices and that connections for ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 6. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
 7. Disable automatic temperature control operators.
- B. Starting procedures for fans:
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for air-handling-system testing, adjusting, and balancing.

3.4 DEMONSTRATION

- A. Demonstration Services: Train Owner's maintenance personnel on the following:
1. Procedures and schedules related to start-up and shutdown, troubleshooting, servicing, preventative maintenance, and how to obtain replacement parts.
 2. Familiarization with contents of Operating and Maintenance Manuals specified in Division 1 Section "Closeout Procedures" and Division 23 Section "General Mechanical Requirements."
- B. Schedule training with at least 7 days' advance notice.

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

END OF SECTION

SECTION 233713

DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this Section.
- B. Types of outlets and inlets required for project include the following:
 - 1. Wall registers and grilles.
- C. Refer to other Division 23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets; not work of this Section.
- D. Refer to other Division 23 sections for balancing of air outlets and inlets; not work of this Section.

1.2 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. AHRI Compliance: Test and rate air outlets and inlets in accordance with AHRI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate air outlets and inlets in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual".
 - 4. ADC Seal: Provide air outlets and inlets bearing ADC Certified Rating Seal.
 - 5. AMCA Compliance: Test and rate louvers in accordance with AMCA 500 "Test Method for Louvers, Dampers and Shutters".
 - 6. AMCA Seal: Provide louvers bearing AMCA Certified Rating Seal.
 - 7. NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for air outlets and inlets including the following:
 - 1. Schedule of air outlets and inlets indicating drawing designation, room location, number furnished, model number, size, and accessories furnished.
 - 2. Data sheet for each type of air outlet and inlet, and accessory furnished; indicating construction, finish, and mounting details.
 - 3. Performance data for each type of air outlet and inlet furnished, including aspiration ability, temperature and velocity traverses; throw and drop; and noise criteria ratings at specified airflows. Indicate selections on data.
 - 4. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of air outlet and inlet, indicating materials and methods of assembly of components.
 - 5. Maintenance Data: Submit maintenance data, including cleaning instructions for finishes, and spare parts lists. Include this data, product data, and shop drawings in maintenance manuals; in accordance with requirements of Division 1.
- B. Coordination Drawings: Reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other items installed in ceilings and walls.

PART 2 - PRODUCTS AND MATERIALS

2.1 REGISTERS AND GRILLES

- A. General: Except as otherwise indicated, provide manufacturer's standard registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and provided with accessories as required for a 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 and 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 registers and grilles of type, capacity, and with accessories and finishes as scheduled on the drawings.
- E. Manufacturers: Subject to compliance with requirements, provide registers and grilles of one of the following:
 - 1. Price Industries, Inc.
 - 2. Krueger Mfg. Co.
 - 3. Titus HVAC

PART 3 - EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which air outlets and inlets are to be installed for compliance with installation tolerances and conditions that would affect the performance of the equipment. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install air outlets and inlets in accordance with manufacturer's written instructions, design drawings, referenced standards, and in accordance with recognized industry practices to ensure that products serve intended function.
- B. Coordinate with other work, including ductwork and duct accessories, to interface installation of air outlets and inlets with other work.
- C. Where a 90-degree elbow is required at the connection to air devices, provide a rigid duct elbow or, at Contractor's option, a flexible elbow assembly as specified in Division 23 section "Metal Ducts".

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before beginning air balance.

3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove dirt and smudges. Replace any air device that has damaged finishes.

END OF SECTION

SECTION 237413

OUTDOOR PACKAGED HEATING AND COOLING UNITS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. Section includes package rooftop heating and cooling units.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 22 Section "Natural Gas Systems" for natural gas equipment connection requirements.
 - 2. Division 23 Sections for temperature controls and other mechanical equipment not specified in this Section, but required for a complete installation.
 - 3. Division 26 Sections for electrical work including motor starters, disconnects, wires/cables, raceways, and other electrical equipment devices not specified in this Section, but required for a complete installation.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions. Provide short circuit current rating of units with factory mounted starter or variable frequency drive.
- B. Shop Drawings:
 - 1. Submit manufacturer's assembly-type shop drawings indicating dimensions, required clearances, and methods of assembly of components
 - 2. Submit shop drawings detailing the mounting, securing, and flashing of the roof curb to the roof structure. Indicate coordinating requirements with roof membrane system.
- C. Wiring Diagrams: Submit wiring diagrams detailing the manufacturer's electrical requirements for power supply wiring for rooftop heating and cooling 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. Operation and Maintenance Data: Submit maintenance data and parts list for each rooftop unit, including "trouble-shooting" maintenance guide, servicing guide and preventative maintenance schedule and procedures. Include this data in maintenance manual; in accordance with requirements of Division 1.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Gas-fired furnace section construction shall be in accordance with AGA safety standards. Furnace section shall bear the AGA label.
 - 2. AHRI Compliance:
 - a. Testing and rating of rooftop units of 135,000 btu/hr capacity or over shall be in accordance with AHRI 360 "Standard for Commercial and Industrial Unitary Air-Conditioning Equipment".

- b. Capacity ratings for water coils shall comply with AHRI 410, "Forced-Circulation Air-Cooling and Air-Heating Coils."
 - c. Sound testing and rating of units shall be in accordance with AHRI 270 "Standard for Sound Rating of Outdoor Unitary Equipment". Units shall bear Certified Rating Seal.
3. Refrigerating system construction of rooftop units shall be in accordance with ASHRAE 15 "Safety Code for Mechanical Refrigeration".
 4. Energy Efficiency Ratio (EER) of rooftop units shall be equal to or greater than prescribed by ASHRAE 90.1-2004 "Energy Standard For Buildings Except Low-Rise Residential Buildings".
 5. Rooftop units shall be listed by UL and have UL label as a unit.
 6. Rooftop units shall be designed, manufactured, and tested in accordance with UL requirements.

1.4 SPARE PARTS

- A. General: Furnish to Owner, with receipt, the following spare parts for each rooftop heating and cooling unit.
 1. One set of spare filters of each type required for each unit. Obtain receipt from Owner that spare filters have been provided. In addition to the spare set of filters, install new filters at completion of installation work, and prior to testing, adjusting, and balancing work.
 2. If HVAC equipment is used during the construction period, Contractor shall provide one set of filters (if system is designed to include pre-filters and after-filters, provide only pre-filters) when the unit is started and replace filters when needed, but not less than every month. On the day of substantial completion, the Contractor shall clean the unit and provide a new set of filters at each location in the unit.

1.5 SPECIAL WARRANTY

- A. Warranty on Compressor and Heat Exchanger: Provide written warranty, signed by manufacturer, agreeing to replace/repair, within warranty period, compressors and heat exchangers with inadequate and defective materials and workmanship, including leakage, breakage, improper assembly, or failure to perform as required; provided manufacturer's instructions for handling, installing, protecting, and maintaining units have been adhered to during warranty period. Replacement is limited to component replacement only, and does not include labor for removal and reinstallation.
 1. Warranty Period: 5 years from date of substantial completion.

PART 2 - PRODUCTS AND MATERIALS

2.1 ROOFTOP UNITS 20 TONS AND LARGER

- A. Manufacturers: Subject to compliance with requirements, provide rooftop units of one of the following:
 1. Aeon, Inc.
 2. Daikin Applied.
 3. Trane (The) Co; Div of American Standard Inc.
- B. General Description: Rooftop unit shall be factory-assembled and tested, designed for roof or slab installation and, consisting of compressors, condensers, evaporator coils, condenser and

evaporator fans, refrigeration and temperature controls, filters, and dampers. Capacities and electrical characteristics shall be as scheduled on the Drawings.

- C. Casing: Provide manufacturer's standard casing construction, having corrosion protection coating, and exterior finish. Casings shall have removable panels or access doors for inspection and access to internal parts, a minimum of 1" thick, 1.5 pound density thermal insulation, knockouts for electrical and piping connections, and an exterior condensate drain connection, and lifting lugs.
- D. Roof Curbs: Refer to Section "Hangers and Supports for HVAC" for pre-engineered roof equipment supports and Section "Vibration Isolation for HVAC Piping and Equipment" for vibration isolated equipment support bases.
- E. Compressors: Provide serviceable, semi-hermetic, or fully hermetic compressors, complete with integral vibration isolators, and crankcase heaters which de-energize during compressor operation.
 - 1. Units shall have the following capacity control measures to prevent excessive compressor short cycling and prevent evaporator coil from freezing:
 - a. Hot-gas bypass valve and piping on first stage compressor.
 - b. Digital scroll compressor as the first stage.
 - c. Inverter scroll compressor as the first stage.
 - 2. Accessories: Thermal expansion valves, filter dryers, sight glasses, compressor service valves, liquid line service valves; minimum of 2 refrigerant circuits for units having 2 or more compressors; and fan-cycling control for low ambient control to 35 deg F (2 deg C).
- F. Evaporator Fans: Provide forward-curved, centrifugal, belt-driven fans with adjustable sheaves; and permanently lubricated motor bearings.
- G. Condenser Fans: Provide propeller-type, direct-driven fans with permanently lubricated bearings.
- H. Motors: Refer to Section "Common Motor Requirements for HVAC Equipment" for requirements.
- I. Coils:
 - 1. General: Aluminum plate fin and seamless copper tube type. Fins shall have collars drawn, belled and firmly bonded to the tubes by means of mechanical expansion of the tubes. No soldering or tinning shall be used in the bonding process. Coils shall have a galvanized steel casing. Coils shall be mounted in the coil casing with same end connections accessible for service. Coils shall be removable from the unit through the roof or through the piping enclosure. Coil section shall be completely insulated.
 - 2. Refrigerant cooling coils: Refrigerant coils shall have an equalizing type vertical distributor to ensure each coil circuit receives the same amount of refrigerant. Coils shall be proof (450 psig) and leak (300 psig) tested with air pressure under water, then cleaned, dehydrated, and sealed with a holding charge of refrigerant. Provide 1 inch factory installed flexible elastomeric insulation around the suction and liquid lines not directly located above a condensate drain pan. If any piping is exposed to sunlight, provide UV protective coating.
 - 3. Hot Gas Reheat Coil: Provide hot gas reheat coil with staged or modulating control for reheat during dehumidification operation. Hot gas reheat coil shall maintain space temperature when unit is operating in the dehumidification mode. Refer to control drawings.
- J. Condensate Drain Pan: Provide stainless steel condensate drain pan sloped to drain connection.
- K. Heat exchangers: Provide manufacturer's standard construction for gas-fired heat exchangers and burners, designed for minimum of 2-stage operation with minimum efficiency of 80 percent. Provide single gas connection.

1. Operating Controls: Provide the following controls for the gas-fired heat exchangers:
 - a. Redundant gas valves;
 - b. Intermittent pilot ignition;
 - c. Electronic spark ignition system;
 - d. High limit cutout;
 - e. Forced draft proving switch;
 - f. Flame roll-out switch.
- L. Filters Section: Provide 4" thick fiberglass throwaway pleated filters in filter rack, with maximum face velocity of 400 fpm and minimum MERV rating per ASHRAE 52.2 of MERV 13.
- M. Safety Controls: Provide safety controls for:
 1. Low pressure cutout, manual reset type;
 2. High pressure cutout, manual reset type;
 3. Compressor motor overload protection, manual reset type;
 4. Anti-recycling timing device;
 5. Adjustable low-ambient lockout;
 6. Oil pressure switch.
- N. Dampers:
 1. General: Dampers and their operators shall comply with performance requirements specified in Division 23 Section "Instrumentation and Control Devices for HVAC."
 2. Outdoor Air Damper:
 - a. Provide outside air damper constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven.
 - b. Refer to schedules on the drawings for capacity and control method of the outdoor air damper of each unit.
- O. Economizer Control:
 1. Provide economizer system complete with return and outside air dampers, outside air filter, fully modulating electric control system with dry bulb or enthalpy control as scheduled on the drawings, and adjustable mixed-air thermostat.
 2. System shall have 100 percent outside air capability.
 3. Provide automatic changeover through adjustable control device.
- P. Relief Control:
 1. Power Exhaust Fan: Direct drive, propeller type designed for low tip speed. Motors shall be open drip-proof with internal motor protection and permanently lubricated ball bearings.
 2. Damper: Include a relief damper with control type as scheduled on the drawings.
- Q. Variable Air Volume Control: Provide variable frequency drive to modulate fan to meet specified sequence of operation. Refer to Division 23 section "Variable Frequency Drives".
- R. Unit Controls: Solid-state control board and components contain at least the following features:
 1. Indoor fan on/off delay.

2. Default control to ensure proper operation after power interruption.
 3. Service relay output.
 4. Unit diagnostics and diagnostic code storage.
 5. Field-adjustable control parameters.
 6. Dehumidification control with humidistat.
 7. Economizer control.
 8. Gas valve delay between first- and second-stage firing.
 9. Indoor-air quality control with carbon dioxide sensor.
 10. Minimum run time.
 11. Night setback mode.
 12. Return-air temperature limit.
 13. Fan-proving switch to lock out unit if fan fails.
 14. Dirty-filter switch.
- S. DDC Interface: Install stand-alone control module providing link between unit controls and DDC system. Control module shall be compatible with temperature-control system specified in Division 23 section "Direct Digital Control for HVAC". The main building automation system (Honeywell) shall interface with the packaged RTU controls for monitoring, alarms, and temperature adjustment. The integration should occur through BTL (BACnet Testing Labs) Certified. The integration will occur through the existing Honeywell PC-6A controller
- T. Thermostat: Programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:
1. Touch sensitive keyboard.
 2. Automatic switching.
 3. Degree F readout.
 4. LED indicators.
 5. Hour/day programming.
 6. Manual override capability.
 7. Time and operational mode readout.
 8. Status indicator.
 9. Battery backup.
 10. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).
- U. Electrical: Provide a 125 VAC, 20 amp duplex convenience receptacle mounted to unit with a cover UL listed for wet and damp locations when in use. Rooftop units shall be designed to meet the minimum short-circuit withstand rating specified on the drawings.
- V. Refrigerant Type: Provide rooftop units designed to operate with R-410 refrigerant.
- W. Accessories: Units shall include the following accessories:
1. Remote Control Panel: Furnish panel for remote mounting containing control of heating, cooling, evaporator fan, and outdoor damper; and indicator lights for up to 6 unit functions.

2. Anti-recycling control to automatically prevent compressor restart for 5-minutes after shutdown.
3. Low ambient control head pressure control, designed to operate at temperatures down to 0 deg F (-18 deg C).
4. Provide guards to protect the condenser coil from hail or other damage.
5. Thermostat: Assembly shall provide for staged heating and cooling with manual or automatic changeover on standard subbase.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which rooftop units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF ROOFTOP HEATING AND COOLING UNITS

- A. General: Install rooftop units in accordance with manufacturer's installation instructions. Install units plumb and level, firmly anchored in locations indicated, and maintain manufacturer's recommended clearances.
- B. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical installer.
 1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Do not proceed with equipment start-up until wiring installation is acceptable to equipment Installer.
- C. Ductwork: Refer to Division-23 section "Metal Ducts". Connect supply and return ducts to unit with flexible duct connections. Provide transitions to exactly match unit duct connection size.
- D. Piping: Piping installation requirements are specified in other Division 23 sections. The Drawings indicate the general arrangement of piping, valves, fittings, and specialties. The following are specific connection requirements:
 1. Condensate Drain Piping: Route condensate drain to nearest roof drain or to location shown on the drawings. Provide trap, minimum of 1" deeper than fan pressure in inches of water, at drain pan connection and install cleanouts at changes in direction (refer to manufacturer's recommendations for any additional requirements). Size condensate drain piping in accordance with local code and the following:

<u>Piping Length</u>	<u>Size</u>
Less than 10 feet	Same size as unit connection
More than 10 feet	One pipe size larger than unit connection
- E. Connect gas piping to gas-fired heat exchanger according to requirements of Division 22 section "Natural Gas Systems." Provide union with sufficient clearance for burner removal and service.

3.3 ADJUSTING, CLEANING, AND PROTECTING

- A. Adjust fan for required airflow in accordance with Section "Testing, Adjusting and Balancing for HVAC." Tighten belts as required for proper operation.
- B. Adjust damper linkages for proper damper operation.
- C. Clean the entire unit including cabinet interiors just prior to substantial completion to remove foreign material and construction dirt and dust. Vacuum clean fan wheel, fan cabinet, intake plenum cabinet, heat exchange surfaces, cooling/heating coil sections, filter sections, access sections, etc.

3.4 STARTUP

- A. Final Checks Before Start-Up: Perform the following operations and checks before start-up:
1. Remove shipping, blocking, and bracing.
 2. Verify unit is secure on mountings and supporting devices and that connections for piping, ductwork, and electrical are complete. Verify proper thermal overload protection is installed in motors, starters, and disconnects.
 3. Perform cleaning and adjusting specified in this Section.
 4. Disconnect fan drive from motor and verify proper motor rotation direction and verify fan wheel free rotation and smooth bearings operations. Reconnect fan drive system, align belts, and install belt guards.
 5. Lubricate bearings, pulleys, belts, and other moving parts with factory-recommended lubricants.
 6. Set outside-air and return-air mixing dampers to minimum outside-air setting.
 7. Comb coil fins for parallel orientation.
 8. Install clean filters. Do not operate air handling unit without pre-filters installed.
 9. Verify manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in the full-open position.
 10. Disable automatic temperature control operators.
- B. Start-Up Services: Provide the services of a factory-authorized service representative to start-up rooftop units in accordance with manufacturer's written start-up instructions. Do not operate units without filters installed. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
1. Energize motor, verify proper operation of motor, drive system, and fan wheel. Adjust fan to indicated RPM.
 - a. Replace fan and motor pulleys as required to achieve design conditions.
 - b. Measure and record motor electrical values for voltage and amperage.
 - c. Shut unit down and reconnect automatic temperature control operators.
 - d. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for procedures for system testing, adjusting, and balancing.

3.5 TRAINING

- A. General: At a time mutually agreed upon between the Owner and Contractor, provide the services of a factory trained and authorized representative to train Owner's designated personnel for a minimum of four hours on the operation and maintenance of the equipment provided under this section.
- B. Content: Training shall include but not be limited to:
1. Overview of the system and/or equipment as it relates to the facility as a whole.
 2. Operation and maintenance procedures and schedules related to startup and shutdown, troubleshooting, servicing, preventive maintenance and appropriate operator intervention.
 3. Review data included in the operation and maintenance manuals. Refer to Division 1 Section "Operating and Maintenance Data."

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

- C. Certification: Contractor shall submit to the Engineer a certification letter stating that the Owner's designated representative has been trained as specified herein. Letter shall include date, time, attendees and subject of training. The certification letter shall be signed by the Contractor and the Owner's representative indicating agreement that the training has been provided.
- D. Schedule: Schedule training with Owner with at least 7 days' advance notice.

END OF SECTION

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SECTION 260010

GENERAL ELECTRICAL REQUIREMENTS

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 and to all following sections within Division 26.

1.2 SECTION INCLUDES

- A. This Division requires providing complete functioning systems, and each element thereof, as specified, indicated, or reasonably inferred, on the Drawings and in these Specifications, including every article, device, or accessory (whether or not specifically called for by item) reasonably necessary to facilitate each system's functioning as indicated by the design and the equipment specified. Elements of the Work include, but are not limited to, materials, labor, supervision, supplies, tools, equipment, transportation and utilities.
- B. Division 26 of these Specifications, and Drawings numbered with prefixes E, generally describe these systems, but the scope of the electrical work includes all such work indicated in all of the Contract Documents, including, but not limited to: Instructions to Bidders; Proposal Form; General Conditions; Supplementary General Conditions; Architectural, Structural, Mechanical, Plumbing and Electrical Drawings and Specifications; and Addenda.
- C. Drawings are graphic representations of the Work upon which the Contract is based. They show the materials and their relationship to one another, including sizes, shapes, locations, and connections. They also convey the scope of work, indicating the intended general arrangement of the equipment, fixtures, outlets and circuits without showing all of the exact details as to elevations, offsets, control lines, and other installation requirements. Use the Drawings as a guide when laying out the Work and to verify that materials and equipment will fit into the designated spaces, and which, when installed per manufacturers' requirements, will ensure a complete, coordinated, satisfactory and properly operating system.
- D. Specifications define the qualitative requirements for products, materials, and workmanship upon which the Contract is based.

1.3 DEFINITIONS

- A. Whenever used in these Specifications or Drawings, the following terms shall have the indicated meanings:
 - 1. Furnish: "To supply and deliver to the project site, ready for unloading, unpacking, assembling, installing, and similar operations."
 - 2. Install: "To perform all operations at the project site, including, but not limited to, and as required: unloading, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, testing, commissioning, starting up and similar operations, complete, and ready for the intended use."
 - 3. Provide: "To furnish and install complete, and ready for the intended use."
 - 4. Furnished by Owner (or Owner-Furnished) or Furnished by Others: "An item furnished by the Owner or under other Divisions or Contracts, and installed under the requirements of this Division, complete, and ready for the intended use, including all items and services incidental to the Work necessary for proper installation and operation. Include the installation under the warranty required by this Division.
 - 5. Engineer: Where referenced in this Division, "Engineer" is the Engineer of Record and the Design Professional for the Work under this Division.

- a. A Consultant to, and an authorized representative of, the Architect, as defined in the General and/or Supplementary Conditions. When used in this Division, it means increased involvement by, and obligations to, the Engineer, in addition to involvement by, and obligations to, the "Architect".
6. Contract Administrator: Where referenced in this Division, "Contract Administrator" is the primary liaison between the Owner and the Contractor. Specifically, for this project this is "the Architect".
7. AHJ: The local code and/or inspection agency (Authority) Having Jurisdiction over the Work.
8. NRTL: Nationally Recognized Testing Laboratory, as defined and listed by OSHA in 29 CFR 1910.7 (e.g., UL, ETL, CSA, etc.), and acceptable to the Authority having Jurisdiction (AHJ) over this project. Nationally Recognized Testing Laboratories and standards listed are used only to represent the characteristics required and are not intended to restrict the use of other NRTLs that are acceptable to the AHJ, and standards that meet the specified criteria.
9. Substitution: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor. Substitutions include Value Engineering proposals.
 - a. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - b. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor or Owner.
10. Value Engineering: A systematic method to improve the "value" of goods and services by using an examination of function. Value, as defined, is the ratio of function to cost. Value can therefore be increased by either improving the function or reducing the cost. The goal of VE is to achieve the desired function at the lowest overall cost consistent with required performance.
- B. The terms "approved equal", "equivalent", or "equal" are used synonymously and shall mean "accepted by or acceptable to the Engineer as equivalent to the item or manufacturer specified". The term "approved" shall mean labeled, listed, or both, by an NRTL, and acceptable to the AHJ over this project.
- C. Manufacturers: The listing of specific manufacturers does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed are not relieved from meeting these specifications in their entirety.
- D. The following definitions apply to excavation operations:
 1. Additional Excavation: Where excavation has reached indicated sub-grade elevations, if unsuitable bearing materials are encountered, continue excavation until suitable bearing materials are reached. The Contract Sum may be adjusted by an appropriate Contract Modification.
 2. Sub-base: as used in this section refers to the compacted soil layer used in pavement systems between the sub-grade and the pavement base course material.
 3. Sub-grade: as used in this section refers to the compacted soil immediately below the slab or pavement system.
 4. Unauthorized excavation consists of removal of materials beyond indicated sub-grade elevations or dimensions without specific direction from the Contract Administrator.

1.4 REFERENCE STANDARDS

- A. Execute all work in accordance with, and comply at a minimum with, National Fire Protection Association (NFPA) codes, state and local building codes, and all other applicable codes and ordinances in force, governing the particular class of work involved, for performance,

workmanship, equipment, and materials. Additionally, comply with rules and regulations of public utilities and municipal departments affected by connection of services. Where conflicts between various codes, ordinances, rules, and regulations exist, comply with the most stringent. Wherever requirements of these Specifications, Drawings, or both, exceed those of the above items, the requirements of these Specifications, Drawings, or both, shall govern. Code compliance, at a minimum, is mandatory. Construe nothing in these Construction Documents as permitting work not in compliance, at a minimum, with these codes. Bring all conflicts observed between codes, ordinances, rules, regulations and these documents to the Contract Administrator's and Engineer's attention in sufficient time, prior to the opening of bids, to prepare the Supplementary Drawings and Specifications Addenda required to resolve the conflict.

- B. If the conflict is not reported timely, prior to the opening of bids, resolve the conflict and provide the installation in accordance with the governing codes and to the satisfaction of the Contract Administrator and Engineer, without additional compensation. Contractor will be held responsible for any violation of the law.
- C. Obtain timely inspections by the constituted authorities having jurisdiction; and, upon final completion of the Work, obtain and deliver to the Owner executed final certificates of acceptance from these authorities having jurisdiction.
- D. All material, manufacturing methods, handling, dimensions, methods of installation, and test procedures shall conform to industry standards, acts, and codes, including, but not limited to the following, except where these Drawings and Specifications exceed them:

- IBC International Building Code
- ADA Americans with Disabilities Act
- AIA Guidelines for Design and Construction of Hospital and Healthcare Facilities
- AEIC Association of Edison Illuminating Companies
- ANSI American National Standards Institute
- ASTM American Society of Testing Materials
- AWS American Welding Society
- AWWA American Water Works Association
- ICEA Insulated Conductors Engineers Association
- IEEE Institute of Electrical and Electronics Engineers
- IES Illuminating Engineering Society
- NBFU National Board of Fire Underwriters
- NEC National Electrical Code, NFPA 70
- NECA National Electrical Contractors Association
- NEMA National Electrical Manufacturers' Association
- NETA International Electrical Testing Association
- NFPA National Fire Protection Association
- OSHA Occupational Safety and Health Act
- UL Underwriter's Laboratories

- E. Comply with rules and regulations of public utilities and municipal departments affected by connections of services.
- F. Perform all electrical work in compliance with applicable safety regulations, including OSHA regulations. All safety lights, guards, and warning signs required for the performance of the electrical work shall be provided by the Contractor.
- G. Obtain and pay for all permits, licenses and fees that are required by the governing authorities for the performance of the electrical work.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with other divisions for electrical work included in them but not listed in Division 26 or indicated on electrical Drawings.
- B. Visit the site and ascertain the conditions to be encountered in installing the Work under this Division, verify all dimensions and locations before purchasing equipment or commencing work,

and make due provisions for same in the bid. Failure to comply with this requirement shall not be considered justification for omission, alteration, and incorrect or faulty installation of any of the Work under this Division or for additional compensation for any work covered by this Division.

- C. Refer to Drawings and divisions of the other trades and to relevant equipment drawings and shop drawings to determine the extent of clear spaces. Make all offsets required to clear equipment, beams and other structural members, and to facilitate concealing conduit in the manner anticipated in the design.
- D. Provide materials with trim that will fit properly the types of ceiling, wall, or floor finishes actually installed.
- E. Maintain an electrical foreman on the jobsite at all times to coordinate this work with other trades so that various components of the electrical systems is installed at the proper time, fits the available space, and allows proper service access to all equipment. Carry on the Work in such a manner that the Work of the other trades will not be handicapped, hindered, or delayed at any time.
- F. Work of this Division shall progress according to the "Construction Schedule" as described in Division 01 and as approved by the Contract Administrator. Cooperate in establishing these schedules and perform the Work under this Division, in a timely manner in conformance with the construction schedule so as to ensure successful achievement of all schedule dates.

1.6 MEASUREMENTS AND LAYOUTS

- A. The Drawings are schematic in nature, but show the various components of the systems approximately to scale and attempt to indicate how they are to be integrated with other parts of the Work. Figured dimensions take precedence to scaled dimensions. Determine exact locations by job measurements, by checking the requirements of other trades, and by reviewing all Contract Documents. Correct, at no additional costs to the Owner, errors that could have been avoided by proper checking and inspection.

1.7 SUBMITTALS

- A. Refer to Division 01 and General Conditions for submittal requirements, in addition to requirements specified herein.
- B. Submittals and shop drawings shall not contain Henderson Engineer's firm name or logo, nor shall they contain the Henderson Engineer's seal and signature. They shall not be copies of Henderson Engineer's work product. If the Contractor desires to use elements of such product, the license agreement for transfer of information at the end of this section must be used.
- C. Assemble and submit for review manufacturer product literature for material and equipment to be furnished and/or installed under this Division. Literature shall include shop drawings, manufacturer product data, performance sheets, samples, and other submittals required by this Division. Provide the number of submittals required by Division 1; if hard-copy sets are provided, submit a minimum of seven (7) sets. General product catalog data not specifically noted to be part of the specified product will be rejected and returned without review.
- D. Separate submittals according to individual specification sections. Only resubmit those sections requested for resubmittal.
- E. Provide submittals in sufficient detail so as to demonstrate compliance with these Contract Documents and the design concept. Highlight, mark, list or indicate the materials, performance criteria and accessories that are being proposed. Illegible submittals will be rejected and returned without review.
- F. Refer to individual sections for additional submittal requirements.
- G. Transmit submittals as early as required to support the project schedule. Allow two weeks for Engineer review time, plus to/from mailing time via the Contract Administrator, plus a duplication of this time for resubmittals, if required. Transmit submittals as soon as possible after Notice to Proceed and before electrical construction starts.

- H. Before transmitting submittals and material lists, verify that the equipment submitted is mutually compatible with and suitable for the intended use. Verify that the equipment will fit the available space and maintain manufacturer recommended service clearances. If the size of equipment furnished makes necessary any change in location, or configuration, submit a shop drawing showing the proposed layout.
- I. Submittals shall contain the following information:
 - 1. The project name.
 - 2. The applicable specification section and paragraph.
 - 3. Equipment identification acronym as used on the drawings.
 - 4. The submittal date.
 - 5. The Contractor's stamp, which shall certify that the stamped drawings have been checked by the Contractor, comply with the Drawings and Specifications, and have been coordinated with other trades.
 - 6. Submittals not so identified will be returned to the Contractor without action.
- J. Refer to Division 1 for acceptance of electronic submittals for this project. For electronic submittals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Engineer that the submittals have been posted. If electronic submittal procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the submittals. For submittals sent by e-mail, Contractor shall copy the Contractor Administrator's and Engineer's designated representatives. Contractor shall allow for the Engineer review time as specified above in the construction schedule. Contractor shall submit only the documents required to purchase the materials and/or equipment in the submittal.
- K. The checking and subsequent acceptance by the Engineer and/or Contract Administrator of submittals shall not relieve responsibility from the Contractor for (1) deviations from the Drawings and Specifications; (2) errors in dimensions, details, sizes of equipment, or quantities; (3) omissions of components or fittings; and (4) not coordinating items with actual building conditions and adjacent work. Contractor shall request and secure written acceptance from the Engineer and Contract Administrator prior to implementing any deviation.

1.8 SUBSTITUTIONS

- A. Refer to Division 1 and General Conditions for substitutions in addition to requirements specified herein.
- B. Materials, products, equipment, and systems described in the Bidding Documents establish a standard of required function, dimension, appearance and quality to be met by the proposed substitution.
- C. The base bid shall include only the products from manufacturers specifically named in the drawings and specifications.
- D. Request for Substitution:
 - 1. Complete and send the Substitution Request Form attached at the end of this section for each material, product, equipment, or system that is proposed to be substituted.
 - 2. The burden of proof of the merit of the proposed substitution is upon the proposer.
 - 3. Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner the following:
 - a. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
 - b. Proposed substitution is consistent with the Contract Documents and will produce indicated results, including functional clearances, maintenance service, and sourcing of replacement parts.

- c. Proposed substitution has received necessary approvals of the Authorities Having Jurisdiction.
 - d. Same warranty will be furnished for proposed substitution as for specified Work.
 - e. If accepted substitution fails to perform as required, Contractor shall replace substitute material or system with that originally specified and bear costs incurred thereby.
 - f. Coordination, installation and changes in the Work as necessary for accepted substitution will be complete in all respects.
- E. Substitution Consideration:
- 1. No substitutions will be considered unless the Substitution Request Form is completed and attached with the appropriate substitution documentation.
 - 2. No substitutions will be considered prior to receipt of bids unless written request for approval to bid has been received by the Engineer at least ten (10) calendar days prior to the date for receipt of bids.
 - 3. If the proposed substitution is approved prior to receipt of bids, such approval will be stated in an addendum. Bidders shall not rely upon approvals made in any other manner. Verbal approval will not be given.
 - 4. No substitutions will be considered after the Contract is awarded unless specifically provided in the Contract Documents.

1.9 ELECTRONIC DRAWING FILES

- A. In preparation of shop drawings or record drawings, Contractor may, at their option, obtain electronic drawing files in AutoCAD or DXF format from the Engineer for a shipping and handling fee of \$200 for a drawing set up to 12 sheets and \$15 per sheet for each additional sheet.
- B. Contractor shall request and complete the Electronic File Release Agreement form from the Engineer. Send the form along with a check made payable to Henderson Engineers, Inc. Contractor shall indicate the desired shipping method and drawing format on the attached form.
- C. Contact the Architect for Architect's written authorization.
- D. The following must be received before electronic drawing files will be sent:
 - 1. Architect's written authorization
 - 2. Engineer's release agreement form
 - 3. Payment

1.10 QUALITY ASSURANCE

- A. Execute all work under this Division in a thorough and professional manner by competent and experienced workmen duly trained to perform the work specified.
- B. Install all work in strict conformance with all manufacturers' requirements and recommendations, unless these Documents exceed those requirements. Install all equipment and materials in a neat and professional manner, aligned, leveled, and adjusted for satisfactory operation, in accordance with NECA guidelines.
- C. Unless indicated otherwise on the Drawings, provide all material and equipment new, of the best quality and design, free from defects and imperfections and with markings or a nameplate identifying the manufacturer and providing sufficient reference to establish quality, size and capacity. Provide all material and equipment of the same type from the same manufacturer whenever practicable.
- D. Unless specified otherwise, manufactured items of the same types specified within this Division shall have been installed and used, without modification, renovation, or repair for not less than one year prior to date of bidding for this Project.

1.11 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Division 1 and General Conditions for Operation and Maintenance Manuals in addition to requirements specified herein.

- B. Submit manuals prior to requesting the final punch list and before all requests for Substantial Completion.
- C. Instruct the Owner's permanent personnel in the proper operation of, startup and shutdown procedures and maintenance of the equipment and components of the systems installed under this Division.
- D. Prior to Substantial Completion of the project, furnish to the Contract Administrator, for Engineer's review, and for the Owner's use, four (4) copies of Operation and Maintenance Manuals in labeled, hard-back three-ring binders, with cover, binding label, tabbed dividers and plastic insert folders for Record Drawings. Include local contacts, complete with address and telephone number, for equipment, apparatus, and system components furnished and installed under this Division of the specifications.
- E. Each manual shall contain equipment data, approved submittals, shop drawings, diagrams, capacities, spare part numbers, manufacturer service and maintenance data, warranties and guarantees.
- F. Refer to Division 1 for acceptance of electronic manuals for this project. For electronic manuals, Contractor shall submit the documents in accordance with this Section and the procedures specified in Division 1. Contractor shall notify the Contract Administrator and Engineer that the manuals have been posted. If electronic manual procedures are not defined in Division 1, Contractor shall include the website, user name and password information needed to access the manuals. For manuals sent by e-mail, Contractor shall copy the Contract Administrator's and Engineer's designated representatives.

1.12 SPARE PARTS

- A. Provide to the Owner the spare parts specified in the individual sections of this Division

1.13 RECORD DRAWINGS

- A. Refer to Division 01 and General Conditions for Record Drawings in addition to requirements specified herein.
- B. A set of work prints of the Contract Documents shall be kept on the jobsite during construction for the purpose of noting changes. During the course of construction, the Contractor shall indicate on these Documents changes made from the original Contract Documents. Particular attention shall be paid to those items which need to be located for servicing. Underground utilities shall be located by dimension from column lines.
- C. At the completion of the project, the Contractor shall obtain, at their expense, reproducible copies of the final drawings and incorporate changes noted on the jobsite work prints onto these drawings. These changes shall be done by a skilled drafter. Each sheet shall be marked "Record Drawing", along with the date. These drawings shall be delivered to the Contract Administrator.

1.14 DELIVERY, STORAGE AND HANDLING

- A. Refer to Division 01 and General Conditions for Delivery, Storage and Handling in addition to requirements specified herein.
- B. Deliver equipment and material to the job site in their original containers with labels intact, fully identified with manufacturer's name, make, model, model number, type, size, capacity and Underwriter's Laboratories, Inc. labels and other pertinent information necessary to identify the item.
- C. Deliver, receive, handle and store equipment and materials at the job site in the designated area and in such a manner as to prevent equipment and materials from damage and loss. Store equipment and materials delivered to the site on pallets and cover with waterproof, tear resistant tarp or plastic or as required to keep equipment and materials dry. Follow manufacturer's recommendations, and at all times, take every precaution to properly protect equipment and material from damage, including the erection of temporary shelters to adequately protect equipment and material stored at the Site. Equipment and/or material which becomes rusted or

damaged shall be replaced or restored by the Contractor to a condition acceptable to the Contract Administrator.

- D. Be responsible for the safe storage of tools, material and equipment.

1.15 WARRANTIES

- A. Refer to Division 01 and General Conditions for Warranties in addition to requirements specified herein.
- B. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
- C. Warrant each system and each element thereof against all defects due to faulty workmanship, design or material for a period of 12 months from date of Substantial Completion, unless specific items are noted to carry a longer warranty in these Construction Documents or manufacturer's standard warranty exceeds 12 months. Remedy all defects, occurring within the warranty period(s), as stated in the General Conditions and Division 01.
- D. Also warrant the following additional items:
 - 1. All raceways are free from obstructions, holes, crushing, or breaks of any nature.
 - 2. All raceway seals are effective.
 - 3. The entire electrical system is free from all short circuits and unwanted open circuits and grounds.
- E. The above warranties shall include labor and material. Make repairs or replacements without any additional costs to the Owner.
- F. Perform the remedial work promptly, upon written notice from the Contract Administrator or Owner.
- G. At the time of Substantial Completion, deliver to the Owner all warranties, in writing and properly executed, including term limits for warranties extending beyond the one year period, each warranty instrument being addressed to the Owner and stating the commencement date and term.

1.16 TEMPORARY FACILITIES

- A. Refer to Division 01 and General Conditions for Temporary Facilities requirements in addition to requirements specified herein.
- B. Temporary Utilities: The types of services required include, but are not limited to, electricity, telephone, and internet. When connecting to existing franchised utilities for required services, comply with service companies' recommendations on materials and methods, or engage service companies to install services. Locate and relocate services (as necessary) to minimize interference with construction operations.
- C. Construction Facilities: Provide facilities reasonably required to perform construction operations properly and adequately.
 - 1. Enclosures: When temporary enclosures are required to ensure adequate workmanship, weather protection and ambient conditions required for the work, provide fire-retardant treated lumber and plywood; provide tarpaulins with UL label and flame spread of 15 or less; provide translucent type (nylon reinforced polyethylene) where daylighting of enclosed space would be beneficial for workmanship, and reduce use of temporary lighting.
 - 2. Heating: Provide heat, as necessary, to protect work, materials and equipment from damage due to dampness and cold. In areas where building is occupied, maintain a temperature not less than 65 degrees F. Use steam, hot water, or gas from piped distribution system where available. Where steam, hot water or piped gas are not available, heat with self-contained LP gas or fuel oil heaters, bearing UL, FM or other approval labels appropriate for application. Vent fuel-burning heaters, and equip units with individual-space thermostatic controls. Use electric-resistance space heaters only where no other, more energy-efficient, type of heater is available and allowable.

1.17 FIELD CONDITIONS

- A. Conditions Affecting Work In Existing Buildings: The following project conditions apply:
1. The Drawings describe the general nature of remodeling to the existing building; however, visit the site prior to submitting bid to determine the nature and extent of work involved.
 2. Schedule work in the existing building with the Owner.
 3. Perform certain demolition work prior to the remodeling. Perform the demolition that involves electrical systems, Light fixtures, equipment, raceways, equipment supports or foundations and materials.
 4. Remove articles that are not required for the new work. Unless otherwise indicated, remove each item removed during this demolition from the premises and dispose in accordance with applicable federal, state and local regulations.
 5. Relocate and reconnect electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical equipment or materials are removed, cap unused raceways below the floor line or behind the wall line to facilitate restoration of finish.
 6. Finish material will be installed under other divisions.
 7. Obtain permission from the Contract Administrator for channeling of floors or walls not specifically noted on the Drawings.
 8. Protect adjacent materials indicated to remain. For work specific to this Division, install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
 9. Locate, identify, and protect electrical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, provide temporary services for affected areas.
- B. Conditions Affecting Excavations: The following project conditions apply:
1. Maintain and protect existing building services that transit the area affected by selective demolition.
 2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
- C. Use of explosives is not permitted.
- D. Environmental Conditions: Apply joint sealers under temperature and humidity conditions within the limits specified by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.

PART 2 - PRODUCTS AND MATERIALS

2.1 SOIL MATERIALS

- A. Sub base Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, crushed slag, or natural or crushed sand.
- B. Drainage Fill: Washed, evenly graded mixture of crushed stone, or crushed or uncrushed gravel, with 100 percent passing a 1-1/2-inch sieve, and not more than 5 percent passing a No. 4 sieve.
- C. Backfill and Fill Materials: Materials complying with ASTM D2487 soil classification groups GW, GP, GM, SM, SW, and SP; free of clay, rock, or gravel larger than two inches in any dimension; debris; waste; frozen materials; and vegetable and other deleterious matter.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.

3.2 EXISTING CONDITIONS

- A. Existing conditions indicated on the Drawings are taken from the best information available from the Owner, existing record drawings, and from limited, in-situ, visual site observations; and, they are not to be construed as "AS BUILT" conditions. The information is shown to help establish the extent of the new work.
- B. Verify all actual existing conditions at the project site and perform the Work as required to meet the existing conditions and the intent of the Work indicated.

3.3 EXISTING UTILITIES

- A. Prepare and submit a schedule of anticipated utility outages indicating dates and duration.
Schedule
- B. Schedule and coordinate with the utility companies, Owner and with the Contract Administrator all connections to, relocation of, or discontinuation of normal utility services from any existing utility line. Include all premium time required for all such work in the bid.
- C. Repair all existing utilities damaged due to construction operations to the satisfaction of the Owner or utility companies without additional cost.
- D. Do not leave utilities disconnected at the end of a workday or over a weekend unless authorized by representatives of the Owner or Contract Administrator.
- E. Make repairs and restoration of utilities before workers leave the project at the end of the workday in which the interruption takes place.
- F. Include in bid the cost of furnishing temporary facilities to provide all services during interruption of normal utility service.

3.4 WORK IN EXISTING FACILITIES

- A. The Drawings describe the general nature of remodeling to the existing facilities; however, visit the site prior to submitting a bid, to determine the nature and extent of work involved.
- B. Schedule work in the existing facility with the Owner.
- C. Certain demolition work shall be performed prior to the remodeling. Perform the demolition that involves electrical systems, fixtures, conduit, wiring, equipment, equipment supports or foundations and materials.
- D. Remove all of these articles that are not required for the new work. Unless otherwise indicated, each item removed during this demolition shall be removed from the premises and disposed of in accordance with all state and local regulations.
- E. 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 Contract Administrator and the Owner no fewer than 7 days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Contract Administrator and the Owner's written permission.
 - 3. Owner reserves the right to require Contractor to cease work in any area Owner requires access to on an emergency basis.
- F. Relocate and reconnect all electrical facilities that must be relocated in order to accomplish the remodeling shown in the Drawings or indicated in the Specifications. Where electrical fixtures or equipment are removed, cap all unused raceways behind the floor line or wall line to facilitate restoration of finish, and, remove all existing wiring from abandoned raceways.

- G. Finish materials are specified in other divisions.
- H. Where removal of existing wiring interrupts electrical continuity of circuits that are to remain in use, provide necessary wiring, raceways, junction boxes, etc., to ensure continued electrical continuity.
- I. Channel walls and floors as required to produce the desired result; however, obtain permission from the Contract Administrator for all channeling not specifically noted on the Drawings.
- J. Provide new, typewritten card directory for distribution equipment (including but not limited to load centers, panelboards, switchboards and switchgear) where changes occur under this scope of work. Indicate exact loads served by each existing circuit breaker or switch.

3.5 PERMITS

- A. Secure and pay for all permits required in connection with the installation of the Electrical Work. Arrange with the various utility companies for the installation and connection of all required utilities for this facility and pay all charges associated therewith including connection charges and inspection fees, except where these services or fees are designated to be provided by others.

3.6 TEMPORARY ELECTRICAL SERVICE AND WIRING

- A. Provide 208Y/120 volt, three-phase, four-wire, temporary electrical service and temporary lighting system to facilitate construction.
- B. In existing facilities, with Owner's approval, Contractor may utilize the existing electrical system as the source of temporary power. Coordinate the point of connection and method of connection to the existing system with the Owner's Representative.
- C. Pay all charges made by the Electric Utility, with respect to installation and energy charges for temporary services.
- D. Work for the temporary power shall consist of all labor and materials, including, but not limited to conduit, wiring, panelboards, fuse blocks, fused disconnecting switches, fuses, pigtails, receptacles, wood panel switch supports, and other miscellaneous materials required to complete the power system.
- E. Install all temporary wiring in accordance with applicable codes, and maintain in an OSHA-approved manner.
- F. Provide an adequate number of GFCI type power distribution centers, rated 208Y/120V, four-wire, and not less than 60A, with sufficient fuse blocks or breakers for lighting and hand tool circuits, 60A four-wire feeders, all mounted within pre-fabricated enclosures UL listed for this application or on suitable wood panels bolted to columns or upright wood supports as required.
- G. Install circuits to points on each level of each building so that service outlets can be reached by a 50-foot extension cord for 120V power and a 100-foot extension cord for 208V power (or as required by OSHA or local authorities).
- H. Provide one lighting outlet per 30 linear feet of corridor and at least one light in each room and for every 800 square feet of floor area. Temporary lighting shall comply with OSHA requirements.
- I. If additional service is required for cranes, electrical welders or for electric motors over 1/2 HP per unit, such additional service shall become the responsibility of the trade involved.
- J. When the permanent wiring for lighting and power is installed, with approval of the Contract Administrator and Owner, the permanent system may be used, provided the Contractor assumes full responsibility for all electrical material, equipment, and devices contained in the systems and provided that roof drainage system and roofing are complete.
- K. When directed by the Contract Administrator, remove all temporary services, lighting, wiring and devices from the property.

3.7 SELECTIVE DEMOLITION

- A. Refer to Division 01, Division 02, and General Conditions for Selective Demolition requirements in addition to the requirements specified herein.

- B. General: Demolish, remove, demount, and disconnect abandoned electrical materials and equipment indicated to be removed and not indicated to be salvaged or saved.
- C. Materials and Equipment To Be Salvaged: remove, demount, disconnect existing electrical materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage.
- D. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.
- E. Electrical Materials and Equipment: Demolish, remove, demount, and disconnect the following items:
 - 1. Inactive and obsolete raceways, fittings, supports and specialties, equipment, wiring, controls, fixtures, and insulation:
 - a. Raceways and outlets embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Cut embedded raceways to below finished surfaces, seal, and refinish surfaces as specified or as indicated on the Architectural Finish Drawings. Remove materials above accessible ceilings. Cap raceways allowed to remain.
 - b. Perform cutting and patching required for demolition in accordance with Division 01, General Conditions and "Cutting and Patching" portion of this Section in Division 26.

3.8 ACCESS TO EQUIPMENT

- A. Locate all pull boxes, junction boxes and controls so as to provide easy access for operation, service inspection and maintenance. Provide an access door where equipment or devices are located above inaccessible ceilings. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Maintain all code required clearances and clearances required by manufacturers.

3.9 PENETRATIONS

- A. Unless otherwise noted as being provided under other divisions, provide sleeves, box frames, or both, for openings in floors, walls, partitions and ceilings for all electrical work that passes through construction. Refer to Division 26 Section "Common Work Results for Electrical".
- B. Provide sleeves, box frames, or both, for all conduit, cable, and busways that pass through masonry, concrete or block walls.
- C. The cutting of new and/or existing construction will not be permitted except by written approval of the Contract Administrator.

3.10 EXCAVATION AND BACKFILLING

- A. Refer to Division 01, Division 02 and General Conditions for Excavation and Backfilling in addition to the requirements specified herein.
- B. Perform excavation of every description, of whatever substance encountered and to the depth required in connection with the installation of the work under this division. Excavation shall be in conformance with applicable Divisions and sections of the Specifications.
- C. Restore roads, alleys, streets and sidewalks damaged during this work to the satisfaction of Authorities Having Jurisdiction.
- D. Do not excavate trenches close to walks or columns without prior consultation with the Contract Administrator.
- E. Erect barricades around excavations, for safety, and place an adequate number of amber lights on or near the work and keep those burning from dusk to dawn. Be responsible for all damage that any parties may sustain in consequence of neglecting the necessary precautions in prosecuting the work.
- F. Slope sides of excavations to comply with local, state and federal codes and ordinances. Shore and brace as required for stability of excavation.

- G. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local, state and federal codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.
 - 1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30 inches below finished grade elevation.
- H. Install sediment and erosion control measures in accordance with local codes and ordinances.
- I. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.
 - 1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
 - 2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches. In no case shall sewers be used as drains for such water.
- J. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
 - 1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
 - 2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.
- K. Excavation for Underground Tanks and Structures: Conform to elevations and dimensions shown within a tolerance of plus or minus 0.10 foot; plus a sufficient distance to permit placing and removal of concrete formwork, installation of services, other construction, and for inspection.
 - 1. Excavate, by hand, areas within drip-line of large trees. Protect the root system from damage and dry-out. Maintain moist conditions for root system and cover exposed roots with burlap. Paint root cuts of one inch in diameter and larger with emulsified asphalt tree paint.
 - 2. Take care not to disturb bottom of excavation. Excavate by hand to final grade just before concrete reinforcement is placed.
- L. Trenching: Excavate trenches for electrical installations as follows:
 - 1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of six to nine inches clearance on both sides of raceway and cables.
 - 2. Excavate trenches to depth indicated or required for raceway and cables to establish slope, away from buildings and indicated elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
 - 3. Limit the length of open trench to that in which raceway and cables can be installed, tested, and the trench backfilled within the same day.
 - 4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of raceway and cables. Provide a minimum of six inches of stone or gravel cushion between rock bearing surface and raceway and cables.
 - 5. Excavate trenches for raceway, cables, and equipment with bottoms of trench to accurate elevations for support of raceway and cables on undisturbed soil.
- M. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35 degrees F.
- N. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.
 - 1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
 - 2. Under building slabs, use drainage fill materials.

3. Under raceway and cables, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
 4. For raceway and cables less than 30 inches below surface of roadways, provide 4-inch-thick concrete base slab support. After installation and testing of raceway and cables, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
 5. Other areas use excavated or borrowed materials.
- O. Backfill excavations as promptly as work permits, but not until completion of the following:
1. Inspection, testing, approval, and locations of underground utilities have been recorded.
 2. Removal of concrete formwork.
 3. Removal of shoring and bracing, and backfilling of voids.
 4. Removal of trash and debris.
- P. Placement and Compaction: Place backfill and fill materials in layers of not more than 8 inches in loose depth for material compacted by heavy equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.
1. For vertical and diagonal raceway installations, thoroughly support raceways from permanent structures or undisturbed earth at no less than 10-foot intervals, while placing backfill materials, so that raceways are not deflected, crushed, broken, or otherwise damaged by the backfill placement.
- Q. 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 specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
- R. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of raceways and equipment by carrying material uniformly around them to approximately same elevation in each lift.
- S. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:
1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 1557 and not less than the following percentages of relative density, determined in accordance with ASTM D 2049, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).
 - a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 90 percent maximum density for cohesive material, or 95 percent relative density for cohesionless material.
 - c. Other Areas: Compact top 6 inches of subgrade and each layer of backfill or fill material to 85 percent maximum density for cohesive soils, and 90 percent relative density for cohesionless soils.
 2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.
- T. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial Completion, remove surface treatment (i.e., pavement, lawn, or other

finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.11 CUTTING AND PATCHING

- A. Provide all necessary cutting of walls, floors, ceilings and roofs for work under this Division.
- B. Cut no structural member without permission from Contract Administrator.
- C. Patch around all openings to match adjacent construction.
- D. After the final waterproofing membrane has been installed, roofs may be cut only with written permission by the Contract Administrator.

3.12 PAINTING

- A. Refer to Division 09 Section "Painting" for painting requirements.
- B. Paint exposed ferrous surfaces, including, but not limited to, hangers, equipment stands and supports using materials and methods as specified under individual sections and Division 09 of the Specifications; colors shall be as selected by the Contract Administrator.
- C. Re-finish all field-threaded ends of galvanized conduits and field-cut ends of galvanized supports with a cold-galvanizing compound approved for use on conductive surfaces. Follow closely manufacturer's instructions for pre-cleaning surfaces and application.
- D. Factory finishes and shop priming and special finishes are specified in the individual equipment Specification sections.
- E. Where factory finishes are provided and no additional field painting is specified, touch up or refinish, as required by, and to the acceptance of, the Contract Administrator, marred or damaged surfaces so as to leave a smooth, uniform finish. If, in the opinion of the Contract Administrator, the finish is too badly damaged to be properly re-finished, replace the damaged equipment or materials at no additional costs to the Owner.

3.13 CLEANING

- A. Remove dirt and refuse, resulting from the performance of the Work, from the premises as required to prevent accumulation. Cooperate in maintaining reasonably clean premises at all times.
- B. Immediately prior to final inspection, make a final cleanup of dirt and refuse resulting from the Work and assist in making the premises broom clean. Clean all material and equipment installed under this Division.
- C. Remove dirt, dust, plaster, stains, and foreign matter from all surfaces.
- D. Touch up and restore damaged finishes to their original condition.

3.14 ADJUSTING, ALIGNING AND TESTING

- A. Adjust, align and test all electrical equipment furnished and/or installed under this Division.
- B. Check motors for alignment with drive and proper rotation, and adjust as required.
- C. Check and test protective devices for specified and required application, and adjust as required.
- D. Check, test and adjust adjustable parts of all light fixtures and electrical equipment as required to produce the intended performance.
- E. Verify that completed wiring system is free from short circuits, unintentional grounds, low insulation impedances, and unintentional open circuits.
- F. After completion, perform tests for continuity, unwanted grounds, and insulation resistance in accordance with the requirements of NFPA 70 and NETA.
- G. Be responsible for the operation, service and maintenance of all new electrical equipment during construction and prior to acceptance by the Owner of the complete project under this Contract. Maintain all electrical equipment in the best operating condition including proper lubrication.
- H. Notify the Contract Administrator immediately of all operational failures caused by defective material, labor or both.

- I. Maintain service and equipment for all testing of electrical equipment and systems until all work is approved and accepted by the Owner.
- J. Keep a calibrated voltmeter and ammeter (true RMS type) available at all times. Provide service for test readings when and as required.
- K. Refer to individual sections for additional and specific requirements.

3.15 START-UP OF SYSTEMS

- A. Prior to start-up of electrical systems, check all components and devices, lubricate items appropriately, and tighten all screwed and bolted connections to manufacturers' recommended torque values using appropriate torque tools.
- B. Each power, lighting and control circuit shall be energized, tested and proved free of breaks, short-circuits and unwanted grounds.
- C. Adjust taps on each transformer for rated secondary voltages.
- D. Balance all single phase loads at each panelboard, redistributing branch circuit connections until balance is achieved to plus or minus 10 percent.
- E. Replace all burned-out lamps. Replace the lamps of all light fixtures that use incandescent, halogen or quartz lamp sources that are installed as part of the finished building, but are used by the Contractor during construction, with new lamps of appropriate type and wattage prior to turning the facility over to the Owner.
- F. After all systems have been inspected and adjusted, confirm all operating features required by the Drawings and Specifications and make final adjustments as necessary.
- G. Demonstrate that all equipment and systems perform properly as designed per Drawings and Specifications.
- H. At the time of final review and tests of the power and lighting systems, all equipment and system components shall be in place and all connections at panelboards, switches, circuit breakers, and the like, shall be complete. All fuses shall be in place, and all circuits shall be continuous from point of service connections to all switches, receptacles, outlets, and the like.

3.16 TEST REPORTS

- A. Perform tests as required by these Specifications and submit the results in the operations and maintenance manuals. The tests shall establish the adequacy, quality, safety, and reliability for each electrical system installed. Notify the Contract Administrator and Engineer two working days prior to each test.
- B. For specific testing requirements of special systems, refer to the Specification section that describes that system.
- C. Upon completing each test, record the results, date and time of each test and the conditions under which the test was conducted. Submit to the Contract Administrator, for Engineer's review, in duplicate, the test results for the following electrical items:
 - 1. Building service entrance voltage and amperes at each phase.
 - 2. Electrical service grounding conditions and grounding resistance.
 - 3. Proper phasing throughout the entire system.
 - 4. Voltages (phase-to-phase and phase-to-neutral) and amperes at each phase for each panelboard, switchboard, and the like.
 - 5. Phase voltages and amperes at each three-phase motor.
 - 6. Test all wiring devices for electrical continuity and proper polarity of connections.
- D. Promptly correct all failures or deficiencies revealed by these tests as determined by the Engineer.

3.17 SUBSTANTIAL COMPLETION REVIEW

- A. Prior to requesting a site observation for "CERTIFICATION OF SUBSTANTIAL COMPLETION", complete the following items:

1. Submit complete Operation and Maintenance Data.
 2. Submit complete Record Drawings.
 3. Perform all required training of Owner's personnel.
 4. Turn over all spares and extra materials to the Owner, along with a complete inventory of spares and extra materials being turned over.
 5. Perform start-up tests of all systems.
 6. Remove all temporary facilities from the site.
 7. Comply with all requirements for Substantial Completion in the Division 01 and General Conditions.
- B. Request in writing a review for Substantial Completion. Give the Contract Administrator at least seven (7) days notice prior to the review.
- C. State in the written request that the Contractor has complied with the requirements for Substantial Completion.
- D. Upon receipt of a request for review, the Contract Administrator will either proceed with the review or advise the Contractor of unfilled requirements.
- E. If the Contractor requests a site visit for Substantial Completion review prior to completing the above-mentioned items, he shall reimburse the Contract Administrator and Engineer for time and expenses incurred for the visit.
- F. Upon completion of the review, the Contract Administrator will prepare a "final list" of outstanding items to be completed or corrected for final acceptance.
- G. Omissions on the "final list" shall not relieve the Contractor from the requirements of the Contract Documents.
- H. Prior to requesting a final review, submit a copy of the final list of items to be completed or corrected. State in writing that each item has been completed, resolved for acceptance or the reason it has not been completed.

END OF SECTION 260010

SUBSTITUTION REQUEST FORM

To Project Engineer: _____ Request # (GC Determined): _____

Project Name: _____

Project No/Phase: _____ Date: _____

Specification Title: _____

Section Number: _____ Page: _____ Article/Paragraph: _____

Proposed Substitution: _____

Manufacturer: _____ Model No.: _____

Address: _____ Phone: _____

History: New product 1-4 years old 5-10 years old More than 10 years old

Differences between proposed substitution and specified Work: _____

Point-by-point comparative data attached – REQUIRED BY ENGINEER

Comparative data may include but not be limited to performance, certifications, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements. Include all information necessary for an evaluation.

Supporting Data Attached: Drawings Product Data Samples
 Tests Reports Other: _____

Reason for not providing specified item: _____

Similar Installation:

Project: _____ Architect: _____

Address: _____ Owner: _____

Date Installed: _____

Proposed substitution affects other parts of Work: No Yes; explain: _____

Substitution Certification Statement:

Unless stated otherwise in writing to the Engineer by the Contractor, Contractor warrants to the Engineer, Architect, and Owner that the:

- ▲ A. Proposed substitution has been fully investigated and determined to meet or exceed the specified Work in all respects.
- B. Proposed substitution is consistent with the Contract Documents and will produce indicated results.
- C. Proposed substitution does not affect dimensions and functional clearances.
- D. Proposed substitution has received necessary approvals of authorities having jurisdiction.
- E. Same warranty will be furnished for proposed substitution as for specified Work.
- F. Same maintenance service and source of replacement parts, as applicable, is available.
- G. Proposed substitution will not adversely affect other trades or delay construction schedule.
- H. Coordination, installation, and changes in the Work as necessary for accepted substitution will be complete in all respects.

Submitting Contractor	Date	Company
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Manufacturer's Certification of Equal Quality:

I _____ represent the manufacturer of the Proposed Substitution item and hereby certify and warrant to Architect, Engineer, and Owner that the function and quality of the Proposed Substitution meets or exceeds the Specified Item.

Manufacturer's Representative	Date	Company
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Engineer Review and Recommendation Section

Recommend Acceptance Yes No
 Additional Comments: Attached None

Acceptance Section:

Contractor Acceptance Signature	Date	Company
Owner Acceptance Signature	Date	Company
Architect Acceptance Signature	Date	Company
Engineer Acceptance Signature	Date	Company

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

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SECTION 260500

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope general construction materials and methods, electrical equipment coordination, and common electrical installation requirements as follows:
1. Access doors in walls, ceilings, and floors for access to electrical materials and equipment.
 2. Sleeves and seals for electrical penetrations.
 3. Joint sealers for sealing around electrical materials and equipment, and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
 4. Sealing penetrations through noise critical spaces.

1.2 DEFINITIONS

- A. The following abbreviations apply to this and other Sections of these Specifications:
1. AHJ: Authority(ies) having Jurisdiction
 2. ATS: Acceptance Testing Specifications
 3. EPDM: Ethylene-propylene-diene monomer rubber
 4. MC: Metal Clad
 5. NBR: Acrylonitrile-butadiene rubber
 6. NRTL: Nationally Recognized Testing Laboratory
 7. PCF: Pounds per Cubic Foot
- B. The following definitions apply to this and other Sections of these Specifications:
1. Homerun: That portion of an electrical circuit originating at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first load.

1.3 ADMINISTRATIVE REQUIREMENTS

- 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, ducts, and other systems installed at required slopes and/or elevations.
 4. So connecting raceways, cables, and wireways 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.
- D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
1. Product data for the following products:
 - a. Sleeve seals.
 - b. Through and membrane penetration firestopping systems.
 - c. Joint sealers
 - d. Acoustical sealers
 2. Shop drawings for:
 - a. Detailed fabrication drawings of access panels and doors.
 3. Through and Membrane Penetration Firestopping Systems Product Schedule: Provide UL listing, location, wall or floor rating and installation drawing for each penetration fire stop system.
 - a. Where Project conditions require modification to qualified testing and inspecting agency's illustrations for a particular firestopping condition, submit illustration, with modifications marked, approved by penetration firestopping manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
 - b. Qualifications data for testing agency.
 4. Record Drawings: Submit Record Drawings as required by Division 1 and Division 26
 - a. Accurately record actual locations of firestopped penetrations and access panel/door locations. Indicate dimensions from fixed structural elements.

1.5 NOISE CRITICAL SPACES

- A. Many areas of the building, referred to as "noise-critical spaces", require special attention (special acoustical provisions and restrictions). The table below designates the noise-critical spaces that will require application of sound attenuating measures and acoustical sealants.
1. Offices
 2. Conference Rooms

PART 2 - PRODUCTS AND MATERIALS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. 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.
 2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 ACCESS TO EQUIPMENT

- A. Available Manufacturers:
1. Bar-Co., Inc.
 2. Elmdor Stoneman.
 3. JL Industries

4. Jay R. Smith Mfg. Co.
 5. Karp Associates, Inc.
 6. Milcor
 7. Nystrom Building Products
 8. Wade
 9. Zurn
- B. Access Doors:
1. Provide access doors for all concealed equipment, except where above lay-in ceilings. Refer to Section "Identification for Electrical Systems" for labeling of access doors.
 2. Access doors shall be adequately sized for the devices served with a minimum size of 18 inches x 18 inches, furnished by the respective Contractor or Subcontractor and installed by the General Contractor.
 3. Access doors must be of the proper construction for type of construction where installed.
 4. The exact location of all access doors shall be verified with the Contract Administrator prior to installation.
 5. Steel Access Doors and Frames: Factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Joints and seams shall be continuously welded steel, with welds ground smooth and flush with adjacent surfaces.
 6. Frames: 16-gauge steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast, or cast-in-place concrete, ceramic tile, or wood paneling.
 - a. For installation in masonry, concrete, ceramic tile, or wood paneling: 1-inch-wide exposed perimeter flange and adjustable metal masonry anchors.
 - b. For installation in gypsum wallboard or plaster: perforated flanges with wallboard bead.
 - c. For installation in full-bed plaster applications: galvanized, expanded metal lath and exposed casing bead, welded to perimeter of frame.
 7. Flush Panel Doors: 14-gauge sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint.
 8. Locking Devices: Flush, screwdriver-operated cam locks.

2.3 SLEEVES

- A. Steel sleeves for raceways and cables
1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends and drip rings.
- B. Cast iron wall pipe sleeves for raceways and cables
1. Manufacturers
 - a. Josam Mfg. Co.
 - b. Smith (Jay R) Mfg. Co.
 - c. Tyler Pipe/Wade Div.; Subs of Tyler Corp.
 - d. Watts Industries, Inc.
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 2. Cast-iron sleeve with integral clamping flange with clamping ring, and nuts for membrane flashing.
 - a. Underdeck Clamp: Clamping ring with setscrews.
 3. Sleeves for rectangular openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
 4. Coordinate sleeve selection and application with selection and application of firestopping to be used.

2.4 SEALANTS

A. SLEEVE SEALS

1. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
2. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. O-Z/Gedney
 - e. Pipeline Seal and Insulator, Inc.
3. Sealing Elements: Interlocking or solid sealing links shaped or pre-drilled to fit surface of cable or raceway. Include type and number required for material and size of raceway or cable.
 - a. EPDM
 - b. NBR
 - c. Neoprene
4. Pressure Plates: Include two for each sealing element. For multi-phase circuits, use slotted pressure plates if metal.
 - a. Plastic
 - b. Carbon steel
 - c. Stainless steel
 - d. PVC-coated steel
5. Connecting Bolts and Nuts: of length required to secure pressure plates to sealing elements. Include one for each sealing element.
 - a. Carbon steel with corrosion-resistant coating
 - b. Stainless steel

B. JOINT SEALERS

1. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Colors: As selected by the Contract Administrator from manufacturer's standard colors.
3. Elastomeric Joint Sealers: Provide the following types:
 - a. One-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
 - b. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
 - c. Products: Subject to compliance with requirements, provide one of the following:
 - 1) One-Part, Nonacid-Curing, Silicone Sealant:
 - a) "Dow Corning 790," Dow Corning Corp.
 - b) "Dow Corning 795," Dow Corning Corp.
 - c) "Silglaze N SCS 2801," General Electric Co.
 - d) "Silpruf SCS 2000," General Electric Co.

- e) "864," Pecora Corp.
 - f) ."Omniseal," Sonneborn Building Products Div
 - g) "Spectrem 1," Tremco, Inc.
 - h) "Spectrem 2," Tremco, Inc.
- 2) One-Part, Mildew-Resistant, Silicone Sealant:
- a) "Dow Corning 786," Dow Corning Corp.
 - b) "Sanitary 1700," General Electric Co.
 - c) "898 Silicone Sanitary Sealant," Pecora Corp.
 - d) "OmniPlus," Sonneborn Building Products Div.
 - e) "Tremsil 600 White," Tremco Corp.
4. Acrylic-Emulsion Sealants: One-part, non-sagging, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent.
- a. Products: Subject to compliance with requirements, provide one of the following:
 - 1) "Chem-Calk 600," Bostik
 - 2) "AC-20," Pecora Corp.
 - 3) "Sonolac," Sonneborn Building Products Div.
 - 4) "Tremflex 834," Tremco, Inc.
- C. FIRESTOPPING
- 1. Sealants and accessories shall have fire-resistance ratings indicated, as established by testing identical assemblies in accordance with UL 2079 or ASTM E 814, by Underwriters' Laboratories, Inc., or other NRTL acceptable to AHJ.
 - a. Manufacturers:
 - 1) Hilti, Inc.
 - 2) RectorSeal.
 - 3) Specified Technologies Inc.
 - 4) 3M Corp.
 - 5) United States Gypsum Company.
- D. ACOUSTICAL SEALANTS sealants
- 1. Foam Backer Rod: Closed cell polyethylene suitable for use as a backing for non-hardening sealant.
 - 2. Non-Hardening Penetration Sealant: Non-hardening polysulphide type, Permanently flexible, approved firestop putty may be used in lieu of the sealant on foam rod in noise critical walls that are also fire rated.
 - 3. Packing Material: Mineral fiber; non-combustible; resistant to water, mildew and vermin. Expanding resilient foams manufactured for this purpose are an acceptable alternative only if the material density is at least 15 PCF (40 kg/m³).

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".
- C. Coordinate seals with wall, ceiling, roof or floor materials and rating of the surface (sound, fire, waterproofing, etc.)

- D. Comply with NECA 1.
- E. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items, unless indicated otherwise.
- F. 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.
- G. 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.
- H. Right of Way: Yield to raceways and piping systems installed at a required slope.

3.2 ACCESS DOORS

- A. Coordinate with architectural finishes to set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces.
- B. Adjust hardware and panels after installation for proper operation.
- C. Label all access doors with a nameplate as described in Division 26 Section "Identification for Electrical Systems".

3.3 SLEEVES AND SLEEVE SEALS

- 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. Provide sleeves for required openings in all concrete and masonry construction and fire, smoke, or both, partitions, for all electrical work that passes through such construction. Coordinate with all other trades and divisions to dimension and lay out all such openings.
- C. Only those openings specifically indicated on the Architectural or Structural Drawings will be provided under other divisions.
- D. Construction in Existing Facilities:
 - 1. Saw cut or core drill existing walls and slabs to install sleeves and sleeve seals in existing facilities. Do not cut or drill any walls or slabs without first coordinating with, and receiving approval from, the Contract Administrator, Owner, or both. Seal sleeves into concrete walls or slabs with a waterproof non-shrink grout acceptable to the Contract Administrator.
- E. 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. Do not cut or core drill new construction without written approval from the Contract Administrator and Structural Engineer.
- F. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- G. Rectangular Sleeve Minimum Metal Thickness:
 - 1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
 - 2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- H. 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.
- I. Install pipe and rectangular sleeves in above-grade walls and slabs, where penetrations are not subject to hydrostatic water pressures. Ensure that drip ring is fully encased and sealed within the wall or slab.
- J. Cut sleeves to length for mounting flush with both surfaces of walls.
- K. Extend sleeves installed in floors 2 inches above finished floor level.

- L. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed; in which case, size sleeves as recommended by the seal manufacturer.
- M. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- N. 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
- O. 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.
- P. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- Q. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (or larger, if required by the seal manufacturer) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- R. Above Grade Concrete or Masonry Penetrations
 - 1. Provide sleeves for cables or raceways passing through above grade concrete or masonry walls, concrete floor or roof slabs. Sleeves are not required for core drilled holes in existing masonry walls, concrete floors or roofs. Provide sleeves as follows:
 - a. Install schedule 40 galvanized steel pipe for sleeves smaller than 6 inches in diameter.
 - b. Install galvanized sheet metal for sleeves 6 inches in diameter and larger, thickness shall be 0.138 inches.
 - c. Install galvanized sheet metal for rectangular sleeves
 - d. Schedule 40 PVC pipe sleeves are acceptable for use in areas without return air plenums.
 - 2. Seal elevated floor, exterior wall and roof penetrations watertight and weather tight with non-shrink, non-hardening commercial sealant. Pack with mineral wool and seal both ends with minimum of 1/2" of sealant.
- S. Underground, Exterior-Wall Penetrations: Install cast-iron wall pipes for sleeves. Size sleeves to allow for 1-inch (or larger, if required by the mechanical sleeve manufacturer) annular clear space between sleeve and cable or raceway. Provide mechanical sleeve seal.
 - 1. Use type and number of sealing elements recommended by manufacturer for pipe material and size. Position pipe in center of sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
 - 2. Inspect installed sleeve and sleeve-seal installation for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade to seal against hydrostatic pressure.
- T. Elevated Floor Penetrations of waterproof membrane:
 - 1. Provide cast-iron wall pipes for sleeves. Size wall pipe for minimum 1/2" annular space between wall pipe and cable or raceway.
 - 2. Pack with mineral wool and seal both ends with minimum of 1/2" of waterproof sealant.
 - 3. Secure waterproof membrane flashing between clamping flange and clamping ring.
 - 4. Extend bottom of wall pipe below floor slab as required and secure underdeck clamp to hold wall pipe rigidly in place.
- U. Interior Foundation Penetration: Provide sleeves for horizontal raceway passing through or under foundation. Sleeves shall be cast iron soil pipe two normal pipe sizes larger than the pipe served.

- V. Interior Penetrations of Non-Fire-Rated Walls: Seal annular space between sleeve and cable or raceway, using joint sealant appropriate for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½” of sealant.
 - W. Exterior Wall Penetrations: Seal annular space between sleeve and raceway or duct, using joint sealant for size, depth, and location of joint. Pack with mineral wool and seal both ends with minimum of ½” of waterproof sealant.
 - X. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
 - Y. Sleeve-Seal Installation
 - 1. Install sleeve seals for all underground raceway penetrations through walls at elevations below finished grade. Additionally, install seals inside raceways, after conductors or cables have been installed, in all raceway penetrations through walls at elevations below finished grade.
 - 2. 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.
 - Z. Inspect installed sleeve and sleeve-seal installations for damage and faulty work. Verify watertight integrity of sleeves and seals installed below grade and above grade where installed to seal against hydrostatic pressure.
- 3.4 FIRESTOPPING
- A. Apply firestopping to electrical penetrations of fire/smoke-rated floor and wall assemblies to restore original fire-resistance rating of assembly.
- 3.5 JOINT SEALERS
- A. Preparation for Joint Sealers
 - 1. Clean surfaces of penetrations, sleeves, or both, immediately before applying joint sealers, to comply with recommendations of joint sealer manufacturer.
 - 2. Apply joint sealer primer to substrates as recommended by joint sealer manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.
 - B. Application of Joint Sealers
 - 1. General: Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
 - a. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealants.
 - b. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
 - 2. Tooling: Immediately after sealant application and prior to time shining or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
 - C. Installation of Fire-Stopping Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical raceways 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.

3.6 ACOUSTICAL PENETRATIONS

- A. Do not allow direct contact of raceways with shaft walls, floor slabs and/or partitions. Sleeve, pack and seal airtight with foam rod, non-hardening sealant and/or packing material, as described herein, for all penetrations by raceway, through surfaces that encompass or are between noise critical spaces. Seal and pack with caulking for the full depth of the penetration all openings around raceways in the structure surrounding the electrical equipment and surrounding noise-critical spaces. This includes all slab penetrations and penetrations of noise critical walls.
- B. Where a raceway passes through a wall, ceiling or floor slab of a noise critical space, cast or grout a metal sleeve into the structure. The internal diameter or dimensions of the sleeve shall be 2 inches larger than the external diameter or dimensions of the raceway passing through it. After all of the raceways are installed in that area, check the clearances and correct, if necessary, to within 1/2-inch. Pack the voids full depth with packing material sealed at both ends, 1-inch deep, with non-hardening sealant backed by foam rod.

END OF SECTION

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

SECTION 260502

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes limited scope for electrical connections to equipment specified under other sections or divisions, or furnished under separate contracts or by the Owner.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Unless otherwise noted, perform all electrical work required for the proper installation and operation of equipment, furnishings, devices and systems specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this contract.
- B. Obtain and review shop drawings, product data, and manufacturer's instructions for equipment furnished under other sections.
- C. Determine connection locations and rough-in requirements based on shop drawings.
- D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- E. Sequence electrical connections to coordinate with start-up schedule for equipment.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products for:
 - 1. Special connectors
 - 2. Special conductors or cable assemblies.
- C. Shop drawings for:
 - 1. Detailing electrical characteristics, wiring diagrams, fabrication and installation for wiring systems.

1.4 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to Authorities Having Jurisdiction.
 - 2. Marked for intended use.
- B. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 CORDS AND CAPS

- A. Attachment Plugs: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6, matching receptacle configuration at outlet provided for equipment, or as required by the equipment manufacturer.
- C. Cord: See Paragraph "Flexible Cords" in Division 26 Section "Low-voltage Electrical Power Conductors and Cables".
- D. Provide cord size suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify conditions of equipment and installation prior to beginning work.
- B. Verify that equipment is ready for connecting, wiring, and energizing.

3.2 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's instructions.

3.3 ELECTRICAL DEVICES

- A. Install disconnect switches, controllers, control stations, and control devices (other than temperature control devices) specified in other divisions of these Specifications, furnished under other contracts, and/or furnished by the Owner for installation under this Contract.

3.4 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturers' instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Make wiring connections using conductors and cable with insulation suitable for temperatures encountered in heat producing equipment.
- D. Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated on the Drawings.
- E. Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Provide interconnecting conduit and wiring between devices and equipment where indicated on the Drawings.

3.5 HVAC EQUIPMENT

- A. When equipment is delivered in separate parts and field assembled, internal wiring, indicated on Shop Drawings as field wiring, will be provided by the equipment supplier, unless otherwise noted.
- B. Provide power connection to all equipment as required and as indicated in the equipment supplier's installation drawings.
- C. Provide all control and interlock wiring for all equipment that is not included within the responsibility of Division 22 or 23.

END OF SECTION

PROJECT MANUAL: PSU WEEDE FIELDHOUSE: PITTSBURG, KS 66762
HENDERSON PROJECT #: 2150001628
PSU PROJECT #: A-014285

SECTION 260504

PROVISIONS FOR ELECTRIC UTILITY SERVICE

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes:
 - 1. Provisions for Underground Secondary Electrical Service.
- B. Utility service voltage:
 - 1. As indicated on the Drawings.
- C. Utility service ampacity: As indicated on the Drawings.
- D. The extent of Work for the secondary electrical service includes providing the following:
 - 1. Raceways
 - 2. Provisions for Metering
 - 3. Grounding and Bonding
 - 4. Service lateral

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Product data for the following products for:
 - a. Meter bases
 - 2. Shop drawings for:
 - a. Utility Company prepared installation drawings
 - b. Cast-in-place concrete pads
- B. Where equipment or materials are specified to comply with utility standards and are listed above as required submittals, obtain approval from the serving utility before submitting to the Architect.
- C. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record actual routing of all exterior buried raceway and all interior conduits two inches and larger. Indicate dimensions from fixed structural elements.

1.3 QUALITY ASSURANCE

- A. Perform all work in accordance with Utility Company installation drawings and service standards.
- B. Maintain one copy of Utility Company installation drawings and service standards at the site.
- C. Prior to commencing work in this Section, meet with the Utility Company representative to review service entrance requirements and details.
- D. Verify that field measurements are as indicated on Utility Company drawings.
- E. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- F. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

(Not Used)

PART 3 - EXECUTION

3.1 SECONDARY SERVICE ENTRANCE UNDERGROUND

- A. Provide an underground secondary service lateral from the pad mounted transformer in accordance with NFPA 70 Article 230 and the Utility Company standards. Reference the Drawings for service lateral conductor and raceway quantities, sizes, and types.
- B. The Utility Company will provide the service transformer.
- C. Provide a concrete pad, complying with the Utility Company standards, for transformer mounting, and set coated GRS conduit elbows and riser(s), with grounding bushing(s), to receive primary and secondary raceways. Where direct burial primary is used, set coated GRS conduit elbow(s) and riser(s), with grounding bushing(s), to receive primary cables.
- D. Make connections to the secondary terminals of the transformer as required and in conformance with Utility Company requirements. Utility Company will provide primary conductors and terminal connections unless otherwise directed by the Utility Company.
- E. Provide underground raceways for primary cables from the transformer pad to the property line, and provide pull cord, per Utility Company standards, for the Utility Company's use in pulling primary conductors. Install raceways a minimum of 24 inches below finished grade line unless otherwise indicated on the Drawings or directed by the Utility Company. Provide excavation and backfill as required to accomplish the installation.

3.2 METERING

- A. The Utility Company will provide the meter and meter wiring.

3.3 UTILITY SERVICE CHARGES

- A. It shall be the responsibility of the Division 26 contractor to apply for the electrical service, including the preparation and completion of all forms. Submit the completed application along with all other required documentation for the new or modified service.
- B. Pay all Utility Company charges for providing electric service, including all charges for bringing primary service to the site.

END OF SECTION 260504

SECTION 260519

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:

1. Conductors, cables, and cords rated 600V and less.
2. Connectors and terminations rated 600V and less.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
- B. Field Quality-Control Test Reports: From Contractor.

1.3 ABBREVIATIONS AND DEFINITIONS

A. The following abbreviations apply to this and other Sections of these specifications:

1. MC: Metal Clad
2. NBR: Acrylonitrile-butadiene rubber

B. The following definitions apply to this and other Sections of these Specifications:

1. HOMERUN: That portion of an electrical circuit beginning at a junction box, termination box, receptacle or switch with termination at an electrical panelboard. Note: Where MC Cable is allowed to be utilized for receptacle and/or lighting branch circuiting loads, the originating point of the homerun shall be at the first load in the circuit or at a junction box in an accessible ceiling space immediately above the first (most upstream) load.

1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 2. Marked for intended use.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS AND MATERIALS

2.1 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.

- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUCTORS AND CABLES

A. General

1. Manufacturers:

- a. AFC Cable Systems, Inc.
- b. Alan Wire
- c. Cerrowire
- d. Colonial Wire & Cable
- e. Encore Wire Corporation
- f. General Cable
- g. Northern Cables Inc.
- h. Okonite Company
- i. Southwire Company

2. Conductor Material: Annealed (soft) copper complying with ICEA S-95-658/NEMA WC70 and UL Standards 44 or 83, as applicable; solid conductor for No. 10 AWG and smaller; concentric, compressed stranded for No. 8 AWG and larger and stranded for all flexible cords, cables, and control wiring.

3. Conductor Insulation Types: Type THHN/THWN-2 and/or XHHW-2 complying with ICEA S-95-658/NEMA WC70 or as noted otherwise below.

4. Sizes of conductors and cables indicated or specified are American Wire Gage (Brown and Sharpe).

5. Unless indicated otherwise, special purpose conductors and cables, such as low voltage control and shielded instrument wiring, shall be as recommended by the system equipment manufacturer.

6. Refer to Part 3 "Conductor and Insulation Applications" Article for insulation type, cable construction, and ratings.

B. Metal Clad Cable, Type MC (Do not use for life safety or critical systems.)

1. MC Cable (with insulated green grounding conductor, no bonding conductor):

a. Manufacturers:

- 1) AFC Cable Systems, Inc (MC Lite)
- 2) Encore Wire Corporation (MC)
- 3) Kaf-Tech
- 4) Southwire Company (Amorlite)

- b. 600V, Unjacketed UL Standard 83, UL Standard 1569 for Type MC, UL Standard 1685, Federal Specification A-A59544, IEEE 1202 Vertical Cable Tray Flame Test and the NEC. Type MC Cable shall be listed for use in UL 1, 2, and 3 Hour Through-Penetration Firestop Systems.

- c. Armor Assembly: Aluminum interlocked armor (aluminum color).

- d. Phase Conductors: Solid soft-drawn copper, THHN-insulated single conductors, color code: ICEA Method 1.

- e. Grounding Conductor: Solid soft-drawn copper, THHN/THWN-2 green insulated grounding conductor sized per NEC Table 250.122.

- f. Marking: Cable markings shall comply with the requirements on NEC ART. 310.11.

2. MC Cable Fittings:

- ##### a. Manufacturer & Model:

- 1) Arlington (4010 AST snap-in type): (SG38 saddle type)
 - 2) Crouse-Hinds (QLK Quick-Lok Series, Saddle type); ACB Series; set-screw, saddle type)
 - 3) O-Z Gedney (AMC-50 speed-lok, saddle type)
 - 4) Thomas & Betts (XC-730 Series cable-lok, saddle type); 3110 Series Tite-Bite)
- b. Fittings used for connecting Type MC cable to boxes, cabinets, or other equipment shall be UL listed and identified for such use with an MCI-A marking on the fitting carton or package.
 - c. Fittings shall be insulated type not requiring the use of anti-short bushings.
 - d. Romex style, clamp type fittings are not acceptable.

C. Single Conductors

1. 600V, THHN/THWN-2 and/or XHHW-insulated conductors, color-coded as follows:

PHASE	120/240V	240Δ/120V	208Y/120V	480Y/277V
A	Black	Black	Black	Brown
B	Red	Orange	Red	Orange
C	N/A	Red	Blue	Yellow
Neutral	White	White	White	Gray**
Equipment Ground	Green	Green	Green	Green
Isolated Ground	N/A	N/A	Green/Yellow Stripe	N/A

**Except as provided in NFPA 70.

2. Where local amendments dictate color-coding of conductors, local amendments shall supersede these color-coding requirements.
3. Conductors shall not be smaller than No. 12 AWG, except that wiring for signal and pilot control circuits and pre-manufactured whips for light fixtures may be No. 14 AWG.

D. Flexible Cords

1. 600V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, extra-hard-usage; Type SO for indoor dry and damp locations; SOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.
2. 300V, multi-conductor (2, 3, or 4 as indicated on the Drawings), oil-resistant black jacket, hard-usage; Type SJO for indoor dry locations; SJOW for damp, wet, and outdoor locations; or as required by the manufacturer of the equipment to which the cords are connected.

E. Control Wiring

1. Refer to Division 23 Section "Direct-Digital Control for HVAC"
2. Unless otherwise noted, all control wiring will be the responsibility of the Section or Division in which the control system is specified.

F. Connectors

1. Manufacturers:
 - a. AMP; Tyco
 - b. FCI-Burndy
 - c. Gould
 - d. Ideal Industries, Inc.
 - e. IlSCO

- f. NSi Industries, Inc.
 - g. O-Z/Gedney
 - h. Panduit
 - i. Thomas and Betts
 - j. 3-M Electrical Products Division
2. Compression connectors for conductors No. 8 AWG and larger: Long-barreled, UL 486-listed, bare copper, circumferential compression type (Burdny "Hylug", or equal), insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - a. Termination fittings: 1-hole pad and inspection port.
 3. Mechanical connections for conductors No. 8 AWG and larger: UL-listed, bare copper and/or tinned aluminum, dual-rated, mechanical type, insulated with clamp-on, cold-shrink, or molded covers, or wrapped with multiple over-lapping layers of 3-M Scotch electrical tape.
 - a. Termination fittings: 1-hole pad and inspection port.
 4. Connectors for solid conductors No. 10 AWG and smaller: Insulated winged wire nuts. Color-coded for size, except use green only for grounding connections.
 5. Connectors for stranded conductors No. 10 AWG and smaller: Tinned copper, insulated-sleeve, compression type, UL-listed, with wire insulation grip. Terminations: flanged fork-tongue type.
 6. Connectors and terminations for aluminum conductors and cables No. 1 and larger: UL 486B listed and marked AL7CU for 75 deg C rated conductors and AL9CU for 90 deg C rated conductors.

PART 3 - EXECUTION

3.1 CONDUCTORS AND CABLES

A. General:

1. Unless otherwise indicated on the Drawings or in other Sections, install all conductors in raceway. Install continuous conductors between outlets, devices and boxes without splices or taps. Do not pull connections into raceways. Leave at least 8 inches of conductor at outlets for fixture or device connections.
2. Use manufacturer-approved pulling compound or lubricant where necessary; compound used shall not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
3. Use pulling means, including fish tape, cable, rope, and basket weave conductor/cable grips that will not damage conductors/cables or raceway.
4. Electrical conductor and cable work is schematically represented on the Drawings. Unless otherwise indicated, conductor sizes shown on the Drawings are based on not more than three single current-carrying conductors in a raceway in free air. Current ratings are based on copper at 75 degrees C temperature rating for all power circuits. Modify raceway and conductor sizing as may be necessitated by any deviation from these conditions. Do not decrease the indicated conductor size due to the use of conductors having a temperature rating of 90 degrees C.
5. Conductor sizes shown are minimum based on code requirements, voltage drop, and/or other considerations. Where approved by the Engineer and at no extra cost to the Owner, larger conductor sizes may be installed at Contractor's option in order to utilize stock sizes, provided raceway sizes are increased where necessary to conform with NFPA 70 (determine the effect of the use of larger conductors on the short circuit current ratings of the electrical equipment, and provide increased short circuit current rated equipment as required).

6. Where parallel conductors are shown, install each set of conductors in separate raceways of essentially the same length.
 7. Seal around cables penetrating fire-rated elements according to Division 07 Section "Penetration Firestopping".
 8. Identify and color-code conductors and cables according to Part 2 of this Section .
 9. Wiring at Outlets: Install conductors at each outlet with at least 6 inches of slack.
 10. Common or Shared Neutrals are not allowed unless shown on the plans or specifically noted to be allowed.
 11. Multi-wire branch circuits (i.e., shared neutral) shall be provided with a means that will simultaneously disconnect all ungrounded conductors at the point the branch circuit originates. Multi-pole breakers or 3 single pole breakers with a handle tie are two example
 12. When multiple home runs are combined into a single raceway such that the number of conductors exceeds four (conductor count is made up of any combination of phase and neutral conductors), the following restrictions apply, which are in addition to those in NFPA 70:
 - a. Emergency Power Circuits – includes all circuits covered under Articles 700, 701 and 702.
 - 1) Maximum of eight conductors in a single raceway. Minimum raceway size: ¾-inch. Do not install any other type of circuit in this raceway.
 - 2) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
 - b. Normal or Non-Essential circuits.
 - 1) Maximum of 16 conductors in a single raceway. For up to eight conductors in a raceway, minimum raceway size: 3/4 inch. For greater than eight conductors, minimum raceway size: 1 inch. Do not install any other type of circuit in this raceway.
 - 2) The minimum wire size for all conductors in this raceway: No. 10 AWG.
 - 3) Only 15A and 20A branch circuit homeruns may be combined into one raceway.
 - c. GFCI-protected circuits.
 - 1) Do not use multi-conductor circuits, with a shared neutral, for any GFCI circuit breaker or receptacle circuit.
 13. For branch circuits fed from GFCI circuit breakers, limit the one-way conductor length to 100 feet between the panelboard and the most remote receptacle or load on the GFCI circuit.
 14. Where the number of conductors for branch circuits is not shown on the Drawings, determine the number of conductors in accordance with NFPA 70. Provide adequate conductors so as to allow performance of all functions of the device.
 15. Provide all conductors with 600V insulation of the following types, unless otherwise noted on the Drawings or in these Specifications:
 - a. Wet or dry locations, in raceways:
 - 1) Service entrance: Type THWN, THHN/THWN-2, or XHHW.
 - 2) Feeders and branch circuits: Type THWN, THHN/THWN-2, or XHHW.
 - 3) Conductors No. 6 AWG and smaller: Types THWN or THHN/THWN-2.
- B. Metal Clad Type MC Cable:
1. Securing and Supporting:
 - a. Support per Art 330 for MC cable
 - b. Secure cable within 12 inches of every box or fitting.
 - c. Secure/supporting intervals shall not exceed six (6) feet for MC cable.

- d. Utilize steel cable hangers, Arlington SMC series or equivalent, for MC cable support wherever possible so as to provide for cable routing in a neat and workmanship like manner.
2. Type MC cable may only be used:
 - a. In lieu of flexible conduit and wiring from light fixtures in accessible ceilings to junction boxes (attached to building structure) above the ceiling. Provide cable whips of sufficient lengths to allow for relocating each light fixture within a 5-foot radius of its installed location, but not exceeding 6 feet in unsupported lengths.
 - b. For vertical drops and horizontal wiring in stud walls.
 - c. In lieu of metal raceway, only for 15A and 20A branch circuits with up to four (4) conductors, not including grounding and/or bonding conductor(s), and only in dry concealed locations above grade, except where specifically not permitted by the NEC.
3. MC Cable shall not be used for any use not listed in the paragraph above. Examples of those uses include, but are not limited to:
 - a. In locations not permitted by the NEC.
 - b. When specifically not allowed by the local AHJ and/or Owner.
 - c. Homeruns to panelboards. Note: where metal clad cable is utilized for receptacle, lighting, and/or miscellaneous load branch circuiting, the originating point of the homerun shall be at the first (most upstream) load in the circuit or at a junction box located in the accessible ceiling space immediately above the first (most upstream) load. Reference definitions in this section for definition on "Homerun".
 - d. Where exposed to view.
 - e. Where subject to physical damage.
 - f. Corrosive or Hazardous locations.
 - g. Wet locations.
 - h. Emergency circuits covered by NFPA Art 700 Emergency Systems
- C. Flexible Cords
 1. Refer to Division 26 Section, "Equipment Wiring Systems", for electrical connections to equipment.
- D. Control Wiring
 1. Unless otherwise indicated on the Drawings or in other sections, install all control wiring in raceway, regardless of voltage. A qualified Electrician shall install all control wire operating at 120V nominal and above. Control wiring operating at less than 120V (e.g., 12V and 24V) may be installed under the Division furnishing it.
 2. Open wiring in air-handling plenums: UL listed and classified for use in air plenums without raceway. Where indicated on the Drawings or specified, and permitted by local codes, only cable for communication or fire alarm systems and low voltage control wiring may be installed without raceways.
- E. Connections:
 1. Apply a zinc based, anti-oxidizing compound to connections.
 2. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
 3. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 4. Use only resin pressure splices and splicing kits that totally encapsulate the splice for splices in underground junction boxes. Arrange the splicing kit to minimize the effects of moisture.

5. Connect conductors No. 6 AWG and larger to panelboards and apparatus by means of approved mechanical lugs or compression connectors.
6. Do not use terminals on wiring devices to feed through to the next device.

3.2 FIELD QUALITY CONTROL

- A. Testing: Perform the following field quality-control testing:
 1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements. Test all wiring prior to energizing to ensure that it is free from unintentional grounds and shorts, is properly phased, and that all connectors are tight.
 2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3. Certify compliance with test parameters.
- B. Test Reports: Prepare a written report to record the following:
 1. Test procedures used.
 2. Test results that comply with requirements.
 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY:

- A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.
- B. This Section includes:
 - 1. Grounding Conductors
 - 2. Connector Products
 - 3. Grounding Electrodes
 - 4. Miscellaneous Grounding Materials and Products

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Product data for the following products:
 - a. Electrodes, mechanical and compression connectors, and exothermic connectors .
- B. Field Quality-Control Test Reports: From Contractor.
 - 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.
- C. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record actual locations of all exterior buried electrodes and all buried ground rings. Indicate dimensions from fixed structural elements.

1.3 DEFINITIONS

- A. The following apply to this and other Sections of these Specifications:
 - 1. EMT: Electrical metallic tubing.
 - 2. ENT: Electrical nonmetallic tubing.
 - 3. FMC: Flexible metal conduit.
 - 4. IMC: Intermediate metal conduit.
 - 5. LFMC: Liquidtight flexible metal conduit.
 - 6. LFNC: Liquidtight flexible nonmetallic conduit.
 - 7. RMC: Rigid Metal Conduit
 - 8. GRS: Galvanized Rigid Steel Conduit
 - 9. RAC: Rigid Aluminum Conduit
 - 10. RNC: Rigid nonmetallic conduit.
 - 11. PSF: Pounds per Square Foot

1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

- B. Test Equipment Suitability and Calibration: Comply with NETA ATS (current version), "Suitability of Test Equipment" and "Test Instrument Calibration."
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
 - 3. Comply with UL 467.
- D. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.
- E. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.
- F. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 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.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 GROUNDING CONDUCTORS, CONNECTORS, AND ELECTRODES:

- A. Manufacturers:
 - 1. Apache Grounding/Erico Inc.
 - 2. Boggs, Inc.
 - 3. Chance/Hubbell.
 - 4. Copperweld Corp.
 - 5. Dossert Corp.
 - 6. Erico Inc.; Electrical Products Group.
 - 7. FCI/Burndy Electrical.
 - 8. Galvan Industries, Inc.
 - 9. Harger Lightning Protection, Inc.
 - 10. Hastings Fiber Glass Products, Inc.
 - 11. Heary Brothers Lightning Protection Co.
 - 12. Ideal Industries, Inc.
 - 13. ILSCO.
 - 14. Kearney/Cooper Power Systems.
 - 15. Korn's: C. C. Korn's Co.; Division of Robroy Industries.
 - 16. Lightning Master Corp.
 - 17. Lyncole XIT Grounding.
 - 18. O-Z/Gedney Co.; a business of the EGS Electrical Group.
 - 19. Panduit, Inc
 - 20. Raco, Inc.; Division of Hubbell.
 - 21. Robbins Lightning, Inc.
 - 22. Salisbury: W. H. Salisbury & Co.

- 23. Superior Grounding Systems, Inc.
- 24. Thomas & Betts, Electrical.

2.3 GROUNDING CONDUCTORS

- A. For insulated conductors, comply with Division 26 Section "Common Work Results for Electrical."
- B. Material: Copper.
- C. Equipment Grounding Conductors: Insulated with green-colored insulation.
- D. Isolated Ground Conductors: Insulated with green-colored insulation with yellow stripe. On feeders with isolated ground, use colored tape, alternating bands of green and yellow tape to provide a minimum of three bands of green and two bands of yellow.
- E. Grounding Electrode Conductors: Bare, stranded, unless otherwise indicated.
- F. Underground Conductors: Bare-copper conductor, No. 2/0 AWG minimum stranded, unless otherwise indicated.
- G. Bare Copper Conductors: Comply with the following:
 - 1. Solid Conductors: ASTM B 3.
 - 2. Assembly of Stranded Conductors: ASTM B 8.
 - 3. Tinned Conductors: ASTM B 33.
- H. Copper Bonding Conductors: As follows:
 - 1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
 - 2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
 - 3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches (wide and 1/16 inch thick).

2.4 CONNECTOR PRODUCTS

- A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.
- B. Bolted Connectors: Bolted-pressure-type connectors
 - 1. Compression Connectors: Burndy Hyground, or equal, permanent, pure, wrought copper, meeting ASTM 8 1 87, essentially the same as the conductors being connected; clearly and permanently marked with the information listed below:
 - a. Company symbol and/or logo.
 - b. Catalog number.
 - c. Conductors accommodated.
 - d. Installation die index number or die catalog number is required.
 - e. Underwriters Laboratories "Listing Mark:".
 - f. The words "Suitable for Direct Burial" or, where space is limited, "Direct Burial" or "Burial" per UL Standard ANSI/UL467 (latest revision).
 - 2. Cast connectors: copper base alloy according to ASTM B 30 (latest revision).
- C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: UL-listed:
 - 1. Copper-clad steel; bonded copper electrolytically-applied to minimum thickness of 10 mils.
 - 2. Size: 5/8 inch by 8 feet. Provide sectional types when longer rods are indicated.
- B. Ground Plates: UL-listed, rectangular, bare solid copper plate; minimum 0.032-inch thick.

MISCELLANEOUS

- A. Test Wells:
 - 1. Traffic Areas: Polymer concrete reinforced with heavy weave fiberglass; H-20 load rating; minimum 24 inches deep.
 - 2. Non-traffic Areas: High density polyethylene; 350 PSF minimum load rating; minimum 10.25 inches deep.
- B. Ground Enhancing Backfill: Provide low-resistivity, ground-enhancing backfill material recommended by the electrode manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. Examine areas and conditions under which electrical grounding connections are to be made and notify the Architect/Engineer in writing of conditions detrimental to proper completion of the work. Do not proceed with Work until unsatisfactory conditions have been corrected.
- B. Provide all materials, labor and equipment for an electrical grounding system in accordance with applicable portions of the NEC and NECA. Coordinate electrical work as necessary to interface installation of electrical grounding systems with other work.
- C. Accomplish grounding and bonding of electrical installations and specific requirements for systems, circuits and equipment required to be grounded for both temporary and permanent construction.

3.2 APPLICATION

- A. Use only copper conductors for both insulated and bare grounding conductors in direct contact with earth, concrete, masonry, crushed stone, and similar materials.
- B. In branch circuit and feeder raceways, use insulated equipment grounding conductors.
- C. Underground Grounding Conductors: Bury at least 24 inches below grade, or 6 inches below the official frost line, whichever is greater.

3.3 EQUIPMENT GROUNDING CONDUCTORS

- A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.
- B. Install equipment grounding conductors in all feeders and branch circuits.
- C. Install insulated equipment grounding conductor with circuit conductors for 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. Feeders and branch circuits installed in non-metallic raceways.
- D. Separately Derived Systems: Bond the derived neutral (grounded) conductor of all separately derived system (e.g., transformers, generators, UPS) to the nearest available grounding electrode, or back to the service grounding electrode if no approved electrodes are readily available. Size the grounding electrode conductor and bonding jumpers as indicated on the Drawings or as required by NFPA 70, whichever is larger.

Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

- F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.
- G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components. On water heaters, bond metal hot and cold water pipes together, across the heater tank.
- H. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 6 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
 - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a ground bar. Size: 1/4-by-2-by-12-inch unless otherwise indicated on Drawings.
 - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.4 INSTALLATION

- A. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.
 - 1. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
 - 2. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
 - 3. Verify that final backfill and compaction has been completed before driving rod electrodes.
- B. Grounding Conductors: Where the size of the grounding conductors are not shown, size in accordance with NFPA 70 Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- C. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.
- D. Metal Water Service Pipe: Provide 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 by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
- E. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.
- F. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
- G. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade, pavement, or floor.

3.5 CONNECTIONS

- A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible. Provide electrical bonding plates, connectors, terminals,

lugs and clamps as recommended by the manufacturers for indicated applications. Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by the manufacturers for types of service indicated.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized steel connections with tin-plated copper jumpers and mechanical clamps.
 5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.
- B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Replace welds that are puffed up or that show convex surfaces indicating improper cleaning. Use exothermic welded connections for the following:
1. Connecting conductors together.
 2. Connecting conductors to ground rods, except at test wells.
 3. Connecting conductors to building steel.
 4. Connecting conductors to plates.
- C. Compression Fittings: Permanent compression-type fittings may be used for the following rather than exothermic connections:
1. Connecting conductors together.
 2. Connecting conductors to building steel.
 3. Connecting conductors to ground rods, except at test wells.
- D. Mechanical Pressure Fittings: Use bolted mechanical (removable) pressure-type clamps for the following:
1. Connecting conductors to ground rods at test wells.
 2. Connecting conductors to pipes.
- E. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.
- F. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
- G. Connections at Test Wells: Use compression-type connectors on conductors and make bolted-and clamped-type connections between conductors and ground rods.
- H. Tighten screws and bolts for grounding and bonding 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.
- I. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.
- J. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.6 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

3.7 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.
2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests by the fall-of-potential method according to IEEE 81.
3. Provide drawings locating each 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.
4. Test Values:
 - a. The resistance between the main grounding electrode and earth ground shall be no greater than 10 ohms.
 - b. Equipment Rated 500 kVA and Less: 10 ohms.
 - c. Equipment Rated 500 to 1000 kVA: 5 ohms.
 - d. Equipment Rated More Than 1000 kVA: 3 ohms.
5. Perform point-to-point megohmmeter tests to determine the resistance between the main grounding system and all major electrical equipment frames, system neutral, and/or derived neutral points.
6. Minimum system neutral-to-ground insulation resistance: one megohm.
7. Investigate point-to-point resistance values that exceed 0.5 ohms.
 - a. Check for loose connections.
 - b. Check for absent or broken connections.
 - c. Check for poor quality welds.
 - d. Consider other reasons.
8. Excessive Grounding Electrode Resistance: If measured resistance to earth ground value exceeds specified values, notify Architect promptly and include recommendations and costs to reduce them.

3.8 GRADING AND PLANTING

- A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 31 and 32. Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Hangers and supports for electrical equipment and systems.
 - 2. Construction requirements for concrete bases.

1.2 DEFINITIONS

- A. EMT: Electrical metallic tubing.
- B. IMC: Intermediate metal conduit.
- C. RMC: Rigid metal conduit.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.4 SUBMITTALS

- A. Product Data: For the following:
 - 1. Steel slotted support systems.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
 - 1. Trapeze hangers. Include Product Data for components.
 - 2. Steel slotted channel systems. Include Product Data for components.
 - 3. Equipment supports.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.

1.6 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."

PART 2 - PRODUCTS

2.1 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.
 - b. Cooper B-Line, Inc.; a division of Cooper Industries.
 - c. ERICO International Corporation.
 - d. GS Metals Corp.
 - e. Thomas & Betts Corporation.
 - f. Unistrut; Tyco International, Ltd.
 - g. Wesanco, Inc.
2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 3. Channel Dimensions: Selected for applicable load criteria.
- B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- C. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored 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 malleable iron.
- E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- F. 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 one of the following:
 - 1) Hilti Inc.
 - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti Inc.
 - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
 6. Toggle Bolts: All-steel springhead type.
 7. Hanger Rods: Threaded steel.

2.2 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 Division 05 Section "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 except if requirements in this Section are stricter.
- B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.
- C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted 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 single-bolt conduit clamps using spring friction action for retention in support channel.
- D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 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, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. 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 (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
 - 6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69 or Spring-tension clamps.
 - 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 reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "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 (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi (20.7-MPa), 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete (Limited Applications)."

C. Anchor equipment to concrete base.

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 (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections 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 260529

SECTION 260533

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

- A. This Section includes:
 - 1. Raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.2 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Shop drawings for:
 - 1. [Detailing fabrication and installation for custom enclosures.
- C. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record actual routing of all exterior buried raceway and all interior raceways three inches and larger. Indicate dimensions from fixed structural elements.

1.3 DEFINITIONS

- A. Terminology used in this specification is as defined below:
 - 1. EMT: Electrical Metallic Tubing
 - 2. FMC: Flexible Metal Conduit
 - 3. GRS: Galvanized Rigid Steel Conduit
 - 4. IMC: Intermediate Metal Conduit
 - 5. LFMC: Liquidtight Flexible Metal Conduit
 - 6. RAC: Rigid Aluminum Conduit
 - 7. RMC: Rigid Metal Conduit
 - 8. RNC: Rigid Nonmetallic Conduit

1.4 QUALITY ASSURANCE

- A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.
- B. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
 - 2. Marked for intended use.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS AND MATERIALS

2.1 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.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 CONDUITS, SURFACE MOUNTED RACEWAYS AND ACCESSORIES

A. Metal Conduit And Tubing

1. Manufacturers:
 - a. AFC Cable Systems, Inc.
 - b. Alflec Corporation, a Southwire Company
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Electri-Flex Co.
 - e. Indalex
 - f. Manhattan/CDT/Cole-Flex
 - g. O-Z/Gedney; Unit of General Signal (Fittings)
 - h. Republic Raceway
 - i. Tyco International; Allied Tube & Conduit Div.
 - j. Western Tube and Conduit Corporation
 - k. Wheatland Tube Co.
2. RMC:
 - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6.
 - b. RAC: ANSI C80.5, UL6A.
3. IMC: ANSI C80.6, UL 1242.
4. EMT and Fittings: ANSI C80.3, UL 797.
 - a. Fittings: Set-screw or compression type.
5. FMC: Aluminum or Zinc-coated steel: UL 1.
6. LFMC: Flexible steel raceway with PVC jacket: UL 360.
 - a. Fittings: NEMA FB 1; compatible with raceway and tubing materials.

B. Nonmetallic Raceway

1. Manufacturers:
 - a. American International.
 - b. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - c. Arnco Corp.
 - d. Cantex Inc.
 - e. Certainteed Corp.; Pipe & Plastics Group.
 - f. Condux International.
 - g. ElecSYS, Inc.
 - h. Electri-Flex Co.
 - i. Lamson & Sessions; Carlon Electrical Products.
 - j. Manhattan/CDT/Cole-Flex.
 - k. Prime Conduit (formerly Carlon)
 - l. RACO; Division of Hubbell, Inc.
 - m. Spiraldut, Inc./AFC Cable Systems, Inc.
 - n. Superflex Ltd.
 - o. Thomas & Betts Corporation.
2. RNC: Schedule 40 PVC: NEMA TC 2, UL 651.
 - a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.

- b. Fittings: match to tubing type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.
- C. Metal Wireways
 - 1. Manufacturers:
 - a. Cooper B-Line
 - b. EPI-Electrical Enclosures
 - c. Hoffman.
 - d. Square D.
 - 2. Material and Construction: 14 gauge (minimum) sheet steel, sized and shaped as indicated, NEMA 1.
 - 3. Fittings and Accessories: Include 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. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70. Where indicated, provide a barrier to divide wireway into compartments.
 - 4. Wireway Covers: Screw-cover type.
 - 5. Finish: Manufacturer's standard phosphate pre-treatment and baked enamel finish.
- D. Surface Metal Raceways
 - 1. Manufacturers:
 - a. Wiremold/Legrand.
 - b. Mono-Systems, Inc.
 - c. Panduit Corp
 - 2. Surface Metal Raceways: Galvanized steel with snap-on covers. Finish with manufacturer's standard prime coating.
 - 3. Types, sizes, and channels as indicated and required for each application, with fittings that match and mate with raceways.

2.3 BOXES, ENCLOSURES AND CABINETS

- A. General
 - 1. Manufacturers:
 - a. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
 - b. Emerson/General Signal; Appleton Electric Company.
 - c. Erickson Electrical Equipment Co.
 - d. Hoffman.
 - e. Hubbell, Inc.
 - f. Killark Electric Manufacturing Co.
 - g. O-Z/Gedney; Unit of General Signal.
 - h. RACO; Division of Hubbell, Inc.
 - i. Robroy Industries, Inc.; Enclosure Division.
 - j. Scott Fetzer Co.; Adalet-PLM Division.
 - k. Spring City Electrical Manufacturing Co.
 - l. Thomas & Betts Corporation.
 - m. Walker Systems, Inc.; Wiremold Company (The).
 - n. Woodhead, Daniel Company; Woodhead Industries, Inc. Subsidiary
- B. Outlet Boxes
 - 1. Sheet Metal Outlet and Device Boxes: NEMA OS 1; UL514A.

2. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
3. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified in the following paragraphs. Manufacturers and model numbers listed are used only to represent the characteristics required and are not intended to restrict the use of other Available Manufacturers listed above and models that meet the specified criteria.
 - a. Boxes for exposed work: deep drawn type with raised covers:
 - 1) Appleton 4S 1/2-DR; 8300 series cover.
 - 2) RACO 190 series; 800 series cover.
 - 3) Steel City 52150 series; RS series cover.
 - b. Concealed and exposed boxes for lighting:
 - 1) Appleton 40-3/4.
 - 2) RACO 160 series.
 - 3) Steel City 54170 series.
 - c. Boxes imbedded in concrete for lighting:
 - 1) Appleton OCR
 - 2) RACO 270 or 280 series.
 - 3) Steel City 54500 series.
 - d. Boxes for flush switches, receptacles, or other general devices:
 - 1) Appleton 4SVB series; 8400 series cover.
 - 2) RACO 198 series; 770 series cover.
 - 3) Steel City CWV series; 52-C-00 series cover.
 - e. Boxes for flush switches, receptacles, or other general devices installed in masonry construction:
 - 1) Appleton MI-250 series or MI-350 series.
 - 2) RACO 690 series or 960 series.
 - 3) Steel City GW series.
 - f. Boxes for telephone, data, telecommunications and audio-video outlets, refer to Division 26 Section and Division 27 Section "Common Work Results for Communications".
 - g. Exposed weatherproof boxes for general devices: cast aluminum with mounting lugs and neoprene gasket:
 - 1) Appleton FDB series.
 - 2) RACO 5300 series.
 - 3) Steel City T100L or LT100L series.
 - h. Exposed weatherproof boxes for general devices: cast aluminum with neoprene gasket:
 - 1) Appleton FS series.
 - 2) RACO 5300 series.
 - 3) Steel City T100 or LT100 series.
- C. Junction and Pull Boxes
 1. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
 2. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast iron or aluminum with gasketed cover.
- D. Cabinets and Enclosures
 1. General:

- a. Compliance: NEMA 250; UL 50 and 508A, as applicable.
- b. NEMA Type 1: Code-gauge phosphatized steel with continuously welded seams; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed removable hinged front cover, with flush keyed latch and concealed hinge; collar studs.
- c. NEMA Type 3R: Code-gauge galvanized steel with drip shield top, seam-free front, side, and back; manufacturer's standard ANSI 61 gray polyester powder finish inside and out; non-gasketed continuous-hinged door, with stainless steel pin; captive, plated steel cover screws; hasp and staple for padlocking; collar studs.
- d. Removable painted steel interior panel mounted on standoffs; metal barriers to separate wiring of different systems and voltages.
- e. Where keyed locks are indicated, provide 2 keys for each enclosure, with all locks keyed alike.
- f. Provide enclosures wider than 36 inches with double doors; removable center posts; internal bracing, supports, or both, as required to maintain their structural integrity; and, accessory feet where required for freestanding equipment.
- g. Provide clamps, grids, slotted wireways, or similar devices to which or by which wiring may be secured. Provide DIN-rail mounted terminal strips for terminating all incoming and outgoing control wiring, and power terminal blocks for incoming/outgoing power wiring.
- h. Provide metal barriers to separate compartments containing control wiring operating at less than 50 volts from power and higher-voltage control wiring.

2.4 FACTORY FINISHES

- A. Finish: For metal wireway and surface raceway, enclosure, or cabinet components, provide manufacturer's standard paint applied to factory-assembled metal wireway and surface raceways, enclosures, and cabinets before shipping.

PART 3 - EXECUTION

3.1 RACEWAYS

A. General

1. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on drawings or in this article are stricter.
2. Provide sizes and types of raceways as indicated on the Drawings. Sizes are based on THWN insulated copper conductors, except where noted otherwise. Where sizes are not shown on the Drawings or in the Specifications, size raceways in accordance with NFPA 70 requirements for the number, size and type of conductors installed. Minimum raceway size: 1/2 inch (concealed and exposed); 1 inch (underground and under slab).
3. Provide all raceways, fittings, supports, and miscellaneous hardware required for a complete electrical system as described by the Drawings and Specifications.
4. Install a green-insulated, equipment-grounding conductor, which is bonded to the electrical system ground, in all raceways, with the exception of Service Entrance raceways.
5. Install grounding bushings on all conduit terminations and bond to the enclosure, equipment grounding conductor, and electrical system ground.
6. Install raceways concealed in walls or above suspended ceilings in finished areas. When approved by the Architect, raceways may be installed concealed in elevated floor slabs. Do not install raceways horizontally within slabs on grade.
7. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

8. 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.
9. Make bends and offsets so inside diameters are not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.
10. Install raceways:
 - a. To meet the requirements of the structure and the requirements of all other Work on the Project.
 - b. To clear all openings, depressions, ducts, pipes, reinforcing steel, and so on.
 - c. Within or passing through the concrete structure in such a manner so as not to adversely affect the integrity of the structure. Become familiar with the Architectural and the Structural Drawings and their requirements affecting the raceway installation. If necessary, consult with the Architect.
 - d. Parallel or perpendicular to building lines or column lines.
 - e. When concealed, with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.
11. Raceways Embedded in Slabs: Install in middle 1/3 of slab thickness where practical and leave at least 2 inches of concrete cover.
 - a. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
 - b. Space raceways laterally to prevent voids in concrete.
 - c. 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.
 - d. Change from RNC to coated GRS or IMC before rising above the floor.
12. Where masonry walls are left unfinished, coordinate raceway installations with other trades so that the raceways and boxes are concealed and the wall will have a neat and smooth appearance.
13. Support raceways from structural elements of the building as required by NFPA 70, Division 26 Section "Hangers and Supports for Electrical Systems". Do not support raceways by hangers used for any other systems foreign to the electrical systems; and, do not attach to other foreign systems. Do not lay raceways on top of the ceiling system.
14. Provide support spacing in accordance with NFPA 70 requirements, and at a minimum in accordance with NEMA standards. Support by the following methods:
 - a. Attach single raceway directly to structural steel with beam clamps.
 - b. Attach single raceway directly to concrete with one-hole clamps or clips and anchors. Outdoors and wherever subject to dampness or moisture, offset raceways from the surface by using galvanized clamps and clamp backs, to mitigate moisture entrapment between raceways and surfaces.
 - c. Attach groups of raceway to structural steel with slotted support system attached with beam clamps. Attach raceway to slotted channel with approved raceway clamps.
 - d. Attach groups of raceway to concrete with cast-in-place steel slotted channel fabricated specifically for concrete embedment. Attach raceway to steel slotted channel with approved raceway clamps.
 - e. Hang plumb horizontally suspended single raceway using a threaded rod. Attach threaded rods to concrete with anchors and to structural steel with beam clamps. Attach raceway to threaded rod with approved raceway clamps.
 - f. Hang horizontally suspended groups of raceway using steel slotted support system suspended from threaded rods. Attach threaded rods to concrete with anchors and to

- structural steel with beam clamps. Attach raceway to steel slotted channel with approved raceway clamps.
- g. Support conductors in vertical raceway in accordance with NFPA 70 requirements.
 - h. Cross-brace suspended raceway to prevent lateral movement during seismic activity.
 - i. Use pre-fabricated non-metallic spacers for parallel runs of underground or under-slab conduits, either direct buried or encased in concrete.
15. Install electrically- and physically-continuous raceways between connections to outlets, boxes, panelboards, cabinets, and other electrical equipment with a minimum possible number of bends and not more than the equivalent of four 90-degree bends between boxes. Make bends smooth and even, without flattening raceway or flaking the finish.
 16. Protect all electrical Work against damage during construction. Repair all Work damaged or moved out of line after rough-in, to meet the Architect's approval, without additional cost to the Owner. Cover or temporarily plug openings in boxes or raceways to keep raceways clean during construction. Clean all raceways prior to pulling conductors or cables.
 17. Align and install raceway terminations true and plumb.
 18. Complete raceway installation before starting conductor installation.
 19. Install a pull cord in each empty raceway that is left empty for installation of wires or cables by other trades or under separate contracts. 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 cord.
 20. Install approved expansion/deflection fittings where raceways pass through or over building expansion joints.
 21. Route raceway through roof openings for piping and ductwork or through roof seals approved by the Architect, the roofing contractor, or both. Obtain approval for all roof penetrations and seal types from the Architect, Owner, roofing contractor, or all three as required to maintain new or existing roofing warranties.
 22. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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 at the following points:
 - a. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces or from building exterior to building interior.
 - b. Where otherwise required by NFPA 70.
 23. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with IMC; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

B. RMC

1. Use GRS or IMC in the following areas:
 - a. Where indicated.
 - b. Exterior applications where above grade and exposed.
 - c. Below grade when concrete-encased, plastic-coated, or provided with a corrosion resistant approved mastic coating.
 - d. All raceways penetrating slabs on grade (use plastic-coated raceway or provide with a corrosion resistant approved mastic coating). This shall include the 90-degree elbow below grade and the entire vertical transition to above grade.
2. Use RAC in the following areas:

- a. Indoors above grade.
 - b. Interior wet or damp locations.
 3. Do not use RAC:
 - a. Below grade.
 - b. Imbedded in concrete or other areas corrosive to RAC.
- C. EMT
 1. Use EMT in the following areas:
 - a. Where indicated.
 - b. Interior concealed locations for:
 - 1) Branch and feeder circuits.
 - 2) Low-voltage control, security, and fire alarm circuits
 2. Do not use EMT:
 - a. Below grade.
 - b. In exterior applications when exposed.
- D. FMC and LFMC
 1. Use FMC or LFMC:
 - a. For the final 24 inches of raceway to all motors, transformers, and other equipment subject to vibration or movement.
 - b. From outlet boxes (attached to building structure) to recessed light fixtures. Install sufficient length to allow for relocating each light fixture within a 5-foot radius of its installed location.
 2. Do not use FMC or LFMC:
 - a. For branch circuits, homeruns or feeders.
 - b. In lengths exceeding 6 feet.
 3. Use FMC only in dry locations; use LFMC in damp, wet, corrosive, and outdoor locations.
- E. RNC
 1. Solvent-weld RNC fittings and raceway couplings per the manufacturer's instructions and make all connections watertight. Use solvent of the same manufacturer as the raceway.
 2. Where installed exposed outdoors or other areas subject to temperature variations, install expansion fittings per Article 352.44 of NFPA 70, to accommodate thermal expansion in straight runs.
 3. Use RNC in the following locations:
 - a. Only where specifically indicated, and then only as specified below.
 - b. Underground, single and grouped, in lieu of GRS or IMC, when indicated.
 - 1) Direct buried
 4. Do not use RNC:
 - a. Exposed indoors
 - b. In occupied spaces.
 - c. In return air plenums.
 - d. Where subject to physical damage.
 - e. Where not permitted by codes.
- F. Raceway Fittings: Compatible with raceways and suitable for use and location.
 1. RMC and IMC: Use threaded rigid steel conduit fittings, unless otherwise indicated.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings and installation tools approved by the manufacturer for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits. Replace all fittings and conduits that have any portion of the coating scraped off to bare metal, at no additional cost to the Owner.
3. Join raceways with fittings designed and approved for that purpose and make joints tight.
4. Use insulating bushings to protect conductors at raceway terminations:
 - a. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
 - b. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

G. Wireways

1. Use flat head screws, clips and straps to fasten wireways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of wireway and unused raceway openings.

H. Surface Raceways

1. Use flat head screws, clips and straps to fasten surface raceways to surfaces. Mount plumb and level.
2. Use suitable insulating bushings and inserts at connections to outlets and corner fittings.
3. Close ends of surface raceway.

3.2 BOXES

A. General

1. Verify locations of device boxes prior to rough in.
2. Set boxes at elevations to accommodate mounting heights as specified or indicated on the Drawings.
3. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Adjust box locations to accommodate intended purpose.
4. Install boxes to preserve fire ratings of walls, floors, and ceilings.
5. Install flush wall-mounted boxes without damaging wall insulation or reducing its effectiveness.
6. Support boxes independently of raceway.
7. Clean the interior of boxes to remove dust, debris, and other material. Clean exposed surfaces and restore finish.
8. Adjust flush-mounted boxes to make front edges flush with finished wall material.
9. Provide boxes of the depth required for the service, device and the application, and with raised covers set flush with the finished wall surface for boxes concealed in plaster finishes. Select covers with the proper openings for the devices being installed in the boxes. Install boxes flush unless otherwise indicated.
10. Install outlet boxes in firewalls complying with UL requirements, with box surface area not exceeding 16 square inches; and, when installed on opposite sides of the wall, separate by a distance of at least 24 inches.

B. Outlet Boxes

1. Install all electrical devices, such as plug receptacles, lamp receptacles, light switches, and light fixtures in or on outlet boxes.

2. Locations of outlets on Drawings are approximate; and, except where dimensions are shown, determine exact dimensions for locations of outlets from plans, details, sections, or elevations on Drawings, or as directed by Architect. Locate outlets generally from column centers and finish wall lines or to centers or joints of wall or ceiling panels.
3. Locate outlet boxes so they are not placed back-to-back in the same wall, and in metal stud walls, so they are separated by at least one stud space, to limit sound transmission from room to room. Install outlet boxes in accessible locations and do not install outlets above ducts or behind furring.
4. Install extension and plaster rings as required by NFPA 70.
5. Carefully set outlet boxes concealed in non-plastered block walls so as to line up with wall joints. Coordinate the box and raceway installation with the wall construction as required for a flush and neat appearing installation. Outlet box extensions may be used where necessary.
6. Do not exceed allowable fill per NFPA 70.
7. Where multiple devices are shown grouped together, gang mount with a common cover plate.

C. Junction and Pull Boxes

1. Install junction and pull boxes above accessible ceilings and in unfinished areas.
2. Provide boxes set flush in painted walls or ceilings with primer coated cover.
3. Where junction and pull boxes are installed above an inaccessible ceiling, locate so as to be easily accessible from a ceiling access panel.
4. Boxes for exterior use shall be:
 - a. Cast iron with cast iron cover sealed and gasketed watertight in vehicular traffic areas. Provide box and cover UL listed for use in vehicular traffic areas.
 - b. Install buried boxes so that box covers are flush with grade, unless indicated otherwise.

3.3 CABINETS AND ENCLOSURES

- A. Unless otherwise indicated on the Drawings, provide NEMA 1 construction for indoor, dry locations; NEMA 12 for indoor, damp and dusty locations; NEMA 3R][4X] for outdoor locations.
- B. Install flush mounted in the wall in finished spaces, with the top 78 inches above finished floor. The front shall be approximately 3/4-inch larger than the box all around.
- C. Install surface mounted in unfinished spaces, with the top 78 inches above finished floor. The front shall be the same height and width as the box.
- D. Electrically ground all metallic cabinets and enclosures. Where wiring to cabinet or enclosure includes a grounding conductor, provide a grounding lug in the interior of the cabinet or enclosure. Cabinets and enclosures specified in this Section are intended to house miscellaneous electrical components assembled in a custom arrangement, such as contactors and relays.
- E. All components that are specified or indicated for assembly in cabinets and enclosures shall each be individually UL listed and labeled. Arrange wiring so that it can be readily identified. Support wiring no less than every 3 inches. Install gauges, meters, pilot lights and controls on the face of the door.
- F. Do not provide cabinets and enclosures smaller than the sizes indicated. Where sizes and types are not indicated, provide cabinets and enclosures of the size, type and classes appropriate for the use and location per the guidelines of the NEC. Provide all items complete with covers and accessories required for the intended use.

END OF SECTION

SECTION 260543

UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL REQUIREMENTS

1.1 SUMMARY

A. This Section includes:

1. Raceways, fittings, and boxes for direct buried and concrete-encased electrical distribution.

1.2 SUBMITTALS

A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements":

1. Product data for the following products:

- a. Raceways, Raceway fittings, separators, duct-bank materials, manholes, handholes, boxes, solvent cement, warning tape and warning planks.

2. Shop drawings for:

- a. Detailing fabrication and installation for custom manholes or handholes including duct entry provisions, reinforcing details, frame and cover design, manhole frame support rings, ladder details, grounding details, sump details, joint details, and cable racks, pulling irons, lifting irons.

B. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":

1. Accurately record actual routing of all exterior buried raceway including coordination with other surrounding utilities and underground structures. Provide scaled plans and sections that Indicate dimensions from finished grade or other fixed structural elements.

1.3 DEFINITIONS

A. Terminology used in this specification is as defined below:

1. GRS: Galvanized Rigid Steel Conduit
2. RMC: Rigid Metal Conduit
3. RNC: Rigid Nonmetallic Conduit

1.4 QUALITY ASSURANCE

A. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 3 years.

B. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that is acceptable to AHJ.
2. Marked for intended use.

C. Comply with NFPA 70 and ANSI C2.

D. Test and inspect pre-cast concrete utility structures according to ASTM C 1037.

E. Non-concrete Handhold and Pull-Box Prototype Test: Test prototypes of manholes 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 a independent testing agency.
2. Strength tests of complete boxes and covers shall be by either an independent testing agency or the 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver ducts to project site with ends capped and store nonmetallic ducts with supports to prevent bending, warping, and deformation.
- B. Store pre-cast and other factory-fabricated underground utility structures at Project site as recommended by manufacturer to prevent physical damage. Arrange so identification markings, if present, are visible.
- C. Lift and support pre-cast concrete units only at designated lifting or supporting points.

1.6 PROJECT CONDITIONS

- A. Interruption of existing electrical service to occupied facilities shall not occur 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 days 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. Coordinate layout and installation of ducts, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field.
- B. Coordinate elevations of ducts and duct-bank entrances into manhole, handholes, and boxes with final locations and profiles of ducts and duct banks as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations from those indicated as required to suit field conditions and to ensure that duct runs drain to manholes and handholes, and as approved by the Architect.

PART 2 - PRODUCTS AND MATERIALS

2.1 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.
- B. Where a list is provided, manufacturers are listed alphabetically and not in accordance with any ranking or preference.

2.2 RACEWAYS AND FITTINGS

- A. Metal Conduit
 1. Manufacturers:
 - a. AFC Cable Systems, Inc.
 - b. Alflex Corporation, a Southwire Company
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Electri-Flex Co.
 - e. Indalex
 - f. Manhattan/CDT/Cole-Flex
 - g. O-Z/Gedney; Unit of General Signal (Fittings)
 - h. Republic Raceway
 - i. Tyco International; Allied Tube & Conduit Div.

- j. Wheatland Tube Co.
 - 2. RMC:
 - a. GRS: Hot-dip galvanized: ANSI C80.1, UL 6
 - 3. Plastic-Coated GRS and Fittings: NEMA RN 1, UL-listed. Coating thickness of 0.40 inches (1 mm), minimum.
 - 4. Fittings: NEMA FB 1; compatible with raceway and tubing materials.
- B. Nonmetallic Raceway
- 1. Manufacturers:
 - a. AFC Cable Systems, Inc. (Tubing)
 - b. American International.
 - c. Anamet Electrical, Inc.; Anaconda Metal Hose.
 - d. Arnco Corp.
 - e. Cantex Inc.
 - f. Certainteed Corp.; Pipe & Plastics Group.
 - g. Condux International.
 - h. ElecSYS, Inc.
 - i. Electri-Flex Co.
 - j. Lamson & Sessions; Carlon Electrical Products.
 - k. Manhattan/CDT/Cole-Flex.
 - l. RACO; Division of Hubbell, Inc.
 - m. Spiralduct, Inc./AFC Cable Systems, Inc.
 - n. Superflex Ltd.
 - o. Thomas & Betts Corporation.
 - 2. RNC: Schedule 40 (type EPC-40-PVC) PVC: NEMA TC 2, UL 651.
 - a. Fittings: match to raceway type and material: NEMA TC 3, NEMA TC 6, UL 651, as applicable.
- C. DUCT ACCESSORIES
- 1. Duct Separators shall be factory-fabricated rigid interlocking spacers, sized for type and sizes of ducts with which used, and selected to provide minimum duct spacings indicated while supporting ducts during concreting or backfilling.
 - 2. Underground-line warning tape specified in Division 26 Section "Identification for Electrical Systems."
 - 3. Concrete warning planks shall be nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
 - a. Color: Red dye added to concrete during batching.
 - b. Labeling: Mark each plank with "ELECTRICAL" in 2-inch high, 3/8-inch deep letters.

PART 3 - EXECUTION

3.1 UNDERGROUND DUCT APPLICATION

- A. Ducts for Electrical Feeders 600 volts and Less: RNC, NEMA Type EPC-40 PVC, in direct-buried duct bank, unless otherwise indicated.

- B. Ducts for Electrical Branch Circuits: RNC, NEMA Type EPC-40 PVC, indirect-buried duct bank, unless otherwise indicated.

3.2 EARTHWORK

- A. Excavation and Backfilling: Comply with Division 31 Section "Earth Moving" but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling and compaction is complete.
- C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Division 32 Sections "Turf and Grasses and "Plants"
- D. Cut and patch existing pavement in the path of underground ducts and utility structures according to Division 01 Section "Cutting and Patching."

3.3 DUCT INSTALLATION

- A. Slope: Pitch ducts a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope ducts from a high point in runs between two manholes to drain in both directions.
- B. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36-inches, both horizontally and vertically, at other locations, unless otherwise indicated.
- C. Joints: Use solvent-cemented joints in ducts and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent ducts do not lie in the same plane.
- D. Duct Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10-inches o.c. for 5-inch ducts, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell with out reducing duct line slope and without forming a trap in the line.
 - 2. Direct-Buried Duct Banks: Install an expansion and deflection fitting in each conduit in the area of disturbed earth adjacent to manhole or handhole.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- E. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet outside the building wall without reducing duct line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition. Install conduit penetrations of building walls as specified in Division 26 Section "Common Work Results for Electrical."
- F. Sealing: Provide temporary closure at termination of ducts that have cables pulled. Seal spare ducts at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- G. Pulling Cord: Install 100-lbf test nylon cord in ducts, including spares.
- H. Direct-Buried Duct Banks:
 - 1. Support ducts on duct separators coordinated with duct size, duct spacing, and outdoor temperature.
 - 2. Space separators close enough to prevent sagging and deforming of ducts, with not less than 5 spacers per 20 feet of duct. Secure separators to earth and to ducts to prevent displacement during backfill and yet permit linear duct movement due to expansion and contraction as temperature changes. Stagger spacers approximately 6-inches between tiers.

3. Excavate trench bottom to provide firm and uniform support for duct bank. Prepare trench bottoms as specified in Division 31 Section "Earth Moving" for pipes less than 6-inches in nominal diameter.
4. Install backfill as specified in Division 31 Section "Earth Moving."
5. After installing first tier of ducts, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand-place backfill to 4-inches over ducts and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end run and complete backfilling with normal compaction as specified in Division 31 Section "Earth Moving."
6. Install ducts with a minimum of 3-inches between ducts for like services and 6-inches between power and signal ducts.
7. Depth: Install top of duct bank at least 36-inches below finished grade, unless otherwise indicated.
8. Set elevation of bottom of duct bank below the frost line.
9. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3-inches of concrete.
 - b. For equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60-inches from edge of base. Install insulated grounding bushings on terminations at equipment.
10. Warning Planks: Bury warning planks approximately 12 inches above all direct-buried ducts and duct banks placing them 24-inches O.C.. Align planks along the width and along the centerline of duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18-inches. Space additional planks 12-inches apart, horizontally.

3.4 GROUNDING

- A. Ground underground ducts and utility structures according to Division 26 Section "Grounding and Bonding for Electrical Systems."

3.5 INSTALLATION ACCEPTANCE

- A. Prior to final acceptance of the duct bank and associated structures, pull an aluminum or wood test mandrel through the duct to prove joint integrity and to verify ducts have not been deformed. Provide mandrel equal to 80 percent fill of the duct. Test duct bank, manhole and handhole grounding to ensure electrical continuity of grounding and bonding connections. Measure and report ground resistance as specified in Division 26 Section "Grounding and Bonding for Electrical Systems." Correct any deficiencies and retest as specified above. Clean internal surfaces of manholes (including sumps) and handholes and remove foreign materials.

END OF SECTION 260543

SECTION 260553

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. This Section includes the following:
 - 1. Nameplates
 - 2. Labels for raceways and metal-clad cable.
 - 3. Labels for junction boxes and pull boxes.
 - 4. Labels for wiring devices and lighting control devices.
 - 5. Markers for conductors, and control cables.
 - 6. Tags.
 - 7. Underground-line warning tape.
 - 8. Warning labels and signs.
 - 9. Instruction signs.
 - 10. Miscellaneous identification products.
 - 11. Painted Identification.

1.2 ADMINISTRATIVE REQUIREMENTS

- A. Where a facility identification standard already exists, that standard shall be continued. Where an identification standard does not exist, color-coding and identification shall be as described herein.
- B. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- D. Coordinate installation of identifying devices with location of access panels and doors.
- E. Install identifying devices before installing acoustical ceilings and similar concealment.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7 and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- B. Comply with NFPA 70.
- C. Comply with 29 CFR 1910.145.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Location, text, and method of identification to be used is noted in individual sections. Refer to related sections for additional identification requirements.

2.2 NAMEPLATES

- A. Engraved, Laminated Acrylic or Melamine Label, adhesive backed. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label;

where 2 lines of text are required, use labels 2 inches (50 mm) high. For elevated components, increase sizes of labels and letters to those appropriate for viewing from the floor.

1. Normal systems - white letters on a black background.

2.3 LABELS FOR RACEWAYS AND METAL-CLAD CABLE

- A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.4 LABELS FOR JUNCTION BOXES AND PULL BOXES

- A. Junction box and pull box covers shall be spray painted to identify the voltage and system. Circuit numbers and the panel they originate from shall be listed on the cover using permanent, waterproof, black ink marker.

2.5 LABELS FOR WIRING DEVICES AND LIGHTING CONTROL DEVICES

- A. Self-laminating Computer Printable Labels: Circuit numbers and the panel they originate from shall be listed on the cover using clear over-laminate to protect legend for permanent, clean identification. Self-laminating Polyester material with white print-on area.
- B. Engraved cover plates: Provide with black letters.

2.6 MARKERS FOR CONDUCTOR AND CONTROL CABLES

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.
- B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.7 TAGS

- A. Write-On Tags: Polyester tag, 0.010 inch (0.25 mm) thick, with corrosion-resistant grommet and polyester or nylon tie for attachment to conductor or cable.
 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.

2.8 UNDERGROUND-LINE WARNING TAPE

- A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
 1. Not less than 6 inches (150 mm) wide by 4 mils (0.102 mm) thick.
 2. Compounded for permanent direct-burial service.
 3. Embedded continuous metallic strip or core.
 4. Printed legend shall indicate type of underground line.

2.9 WARNING LABELS AND SIGNS

- A. Comply with NFPA 70 and 29 CFR 1910.145. Attachment method shall be acceptable to the manufacturers of the equipment to which the nameplates are being applied and shall not compromise any NRTL listing or labeling criteria.
- B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.
- C. Warning label and sign 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 (208 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

3. Workspace Clearance Warning (480 Volts): "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 48 INCHES (915 MM)."

2.10 ARC FLASH WARNING LABELS

- A. 3.5 in. x 5 in., unless otherwise noted by Owner, thermal transfer type label of high adhesion polyester for each work location analyzed.
- B. All labels will be based on recommended overcurrent device settings and will be printed after the results of the analysis have been presented and after any system changes, upgrades, or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 1. Location designation
 2. Nominal voltage
 3. Available fault current
 4. Flash protection boundary
 5. Hazard risk category
 6. Incident energy
 7. Working distance
 8. Engineering report number, revision number and issue date.
- D. Labels shall be machine printed, with no field markings.

2.11 INSTRUCTION SIGNS

- A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes. Unless indicated otherwise, provide with minimum 3/8-inch- (10-mm-) high letters.
 1. Punched or drilled for mechanical fasteners.
 2. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.
 3. Normal systems: Engraved legend with white letters on black face.
 4. Essential Systems: Engraved legend with white letters on red face.

2.12 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
 1. Minimum Width: 3/16 inch (5 mm).
 2. Tensile Strength: 50 lb (22.6 kg), minimum.
 3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
 4. Color: Black, except where used for color-coding.
- B. Fasteners for Nameplates, Labels and Signs
 1. Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers unless otherwise noted.

2.13 PAINTED IDENTIFICATION

- A. Paint materials and application requirements are specified in Division 09 painting Sections.
 1. Exterior Ferrous Metal:
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior ferrous-metal primer.
 - 2) Finish Coats: Exterior semi-gloss alkyd enamel.
 2. Exterior Zinc-Coated Metal (except Raceways):
 - a. Semi-gloss Alkyd-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Exterior zinc-coated metal primer.

- 2) Finish Coats: Exterior semi-gloss alkyd enamel.
3. Interior Gypsum Board:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior gypsum board primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
4. Interior Ferrous Metal:
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior ferrous-metal primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.
5. Interior Zinc-Coated Metal (except Raceways):
 - a. Semi-gloss Acrylic-Enamel Finish: Two finish coat(s) over a primer.
 - 1) Primer: Interior zinc-coated metal primer.
 - 2) Finish Coats: Interior semi-gloss acrylic enamel.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Verify identity of each item before installing identification products.
- B. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- C. Painted Identification: Prepare surface and apply paint according to Division 09 painting sections.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. For surfaces that require finish work, apply identification devices after completing finish work.
- C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- D. Attach non-adhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.
- E. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Identify system voltage with black letters on an orange background. For unfinished areas apply to exterior of door, cover, or other access.
- F. Equipment Nameplates and Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual

END OF SECTION

SECTION 260573

OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes computer-based, fault-current and overcurrent protective device coordination studies, and the setting of these devices.
 - 1. Also include coordination of series-rated devices where series rating is specified in other sections and where indicated on Drawings.
 - 2. The AIC ratings indicated on the Drawings are preliminary and will be finalized based on the results of the fault current study. Device ratings for furnished equipment shall be as required by the results of the fault current study at no additional cost.
- B. Study must be completed and submitted for review prior to final order, assembly or shipping of the electrical distribution system components. If study has not been approved prior to shipping, assembly or final ordering of the electrical distribution system components, all changes to the equipment necessitated by the results of the study will be provided by the contractor at no additional cost to the project.

1.2 SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-study specialist.
- D. Other Action Submittals:
 - 1. Coordination-study input data, including completed computer program input data sheets.
 - 2. Coordination-study report.
 - 3. Equipment evaluation report.
 - 4. Arc-Flash Hazard Analysis.
 - 5. Setting report.
- E. Record Drawings: Submit Record Drawings as required by Division 01 and Division 26 Section "General Electrical Requirements":
 - 1. Accurately record on the One-Line Diagram actual ratings and settings for all overcurrent devices, both adjustable and non-adjustable, including all changes made during construction, due to the study, or both.

1.3 QUALITY ASSURANCE

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination-Study Specialist Qualifications: An organization experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision and control of engineer.
- C. Comply with IEEE 399 for general study procedures.
- D. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

- E. Comply with IEEE 1584 and NFPA 70E for arc-flash hazard calculations.

PART 2 - PRODUCTS AND MATERIALS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, provide computer software programs developed by one of the following:
 - 1. CYME International, Inc.
 - 2. EDSA Micro Corporation.
 - 3. Electrical Systems Analysis, Inc.
 - 4. SKM Systems Analysis, Inc.
 - 5. Operation Technology, Inc.

2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399, Table 7-4.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices.
 - 1. Zero-Sequence current.
 - 2. Arcing faults.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
- B. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices not submitted for approval with coordination study may not be used in study.
- C. Fault current study and coordination study to be performed prior to the final submittals for any piece of electrical equipment which has an AIC rating or an over-current protective device so that correct equipment gets ordered for the project conditions.
- D. Arc Flash Study must be performed after conductors and equipment have been installed and after the project's utility company confirms the available fault current. A final coordination study with all device settings shall be submitted with the Arc Flash Study. The goal of the revised settings is to minimize the arc flash hazard while maintaining reasonable coordination and selectivity. For the components of emergency and legally required standby system components, full selectivity must be maintained.

3.2 SYSTEM COMPONENTS TO BE INCLUDED IN STUDIES

- A. Study shall begin with the utility and each alternate power source overcurrent device(s) serving the Project and end at the last branch circuit overcurrent protective device. This includes studies of the complete paths on both sides of any transfer switch, contactor or circuit breaker.
- B. Components include, but are not limited to:

1. Distribution Panelboards
2. Air Handling Equipment

3.3 POWER SYSTEM DATA FOR STUDIES

A. Gather and tabulate the following input data to support studies:

1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Impedance of utility service entrance.
3. Electrical distribution system diagram showing the following:
 - a. Load current that is the basis for sizing continuous ratings of circuits for cables and equipment.
 - b. Circuit-breaker and fuse-current ratings and types.
 - c. Cables. Indicate conduit material, sizes of conductors, conductor insulation, and length.
 - d. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Magnetic inrush current overload capabilities of transformers.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Ratings, types, and settings of utility company's overcurrent protective devices.
 - e. Special overcurrent protective device settings or types stipulated by utility company.
 - f. Time-current-characteristic curves of devices indicated to be coordinated.
 - g. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - h. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - i. Panelboards, switchboards, motor-control center ampacity, and interrupting ratings in amperes rms symmetrical.

3.4 FAULT-CURRENT STUDY

- A. Source Impedance: Utility company's fault-current contribution as indicated.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project and use approved computer software program to calculate values. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Comply with IEEE 241 recommendations for fault currents and time intervals.
- E. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with the following:
 1. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.50.
 2. Low-Voltage Fuses: IEEE C37.46.
 3. Circuit Breakers: IEEE C37.13.

F. Study Report:

1. Enter calculated X/R ratios and interrupting (5-cycle) fault currents on electrical distribution system diagram of the report.
2. List other output values from computer analysis, including momentary (1/2-cycle), interrupting (5-cycle), and 30-cycle fault-current values for 3-phase, 2-phase, and phase-to-ground faults.

G. Equipment Evaluation Report: Prepare a report on the adequacy of overcurrent protective devices and conductors by comparing fault-current ratings of these devices with calculated fault-current momentary and interrupting duties.

3.5 ARC-FLASH HAZARD ANALYSIS

A. Determine arc-flash incident energy levels and flash protection boundary distances based on the results of the Short-Circuit and Coordination studies. Perform the analysis under worst-case arc-flash conditions for all modes of operation.

B. Identify all locations and equipment to be included in the arc-flash hazard analysis:

1. Include a copy of the facility one-line in the report.
2. Identify the possible system operating modes including tie-breaker positions, and parallel generation.
3. Calculate the arcing fault current flowing through each branch for each fault location.
4. Determine the time required to clear the arcing fault current using the protective device settings and associated trip curves.
5. Select the working distances based on system voltage and equipment class.
6. Calculate the incident energy at each fault location at the prescribed working distance.
7. Determine the hazard/risk category (HRC) for the estimated incident energy.
8. Calculate the flash protection boundary at each fault location.
9. Document the assessment in reports and one-line diagrams.
10. Provide labels to be placed on each piece of equipment analyzed. Label shall show the calculated incident energy and hazard/risk category for the calculated incident energy.

C. Results of the arc-flash study shall be summarized in a final report containing the following:

1. Basis, method of hazard assessment, description, purpose, scope, and date of the study.
2. Tabulations of the data used to model the system components and a corresponding one-line diagram.
3. Descriptions of the scenarios evaluated and identification of the scenario used to evaluate equipment ratings.
4. Tabulations of equipment incident energies, hazard risk categories, and flash protection boundaries. The tabulation shall identify and clearly note equipment that exceeds allowable incident energy ratings.
5. Required arc-flash labeling and placement of labels.
6. Conclusions and recommendations.

END OF SECTION 260573

SECTION 262416

PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. Distribution panelboards.
- B. Disconnecting and Overcurrent Protective Devices.
- C. Accessory Components and Features.

1.2 DEFINITIONS

- A. SVR: Suppressed voltage rating.
- B. SPD: Surge Protection Device

1.3 ADMINISTRATIVE REQUIREMENTS

- 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. Coordinate sizes and locations of concrete bases with actual equipment provided. Concrete, reinforcement, and formwork requirements are specified in Division 03.

1.4 SUBMITTALS

- A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. 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. Show tabulations of installed devices, equipment features, and ratings.
 - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
 - 3. Detail bus configuration, current, and voltage ratings.
 - 4. Short-circuit current rating of panelboards and overcurrent protective devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- 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. Panelboard Schedules: Submit final panelboard directories.
- E. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Routine maintenance requirements for panelboards and all installed components.
 - 2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 - 3. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- 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.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.7 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 23 deg F (minus 5 deg C) to plus 104 deg F (plus 40 deg C).
 - b. Altitude: Not exceeding 6600 feet (2000 m).
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet (2000 m).
- C. Interruption of Existing Electric Service: Do not interrupt electric service to occupied facilities. Refer to Division 26 Section "General Electrical Requirements" for allowable outages.

1.8 WARRANTY

- A. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Square D; a brand of Schneider Electric.
- B. Enclosures: Flush- or surface-mounted cabinets as noted.
 - 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Hinged Front Cover: Entire front trim hinged to box.
 - 3. Door: Standard door with concealed hinges, within hinged trim cover. Secured with vault-type latch with tumbler lock; keyed alike.
 - 4. 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.
- 5. Directory Card: Inside panelboard door, mounted in transparent card holder.
- C. Incoming Mains Location: Top and/or bottom as required.
- D. Buses: Three phase, four wire unless otherwise indicated.
 - 1. Phase, and Neutral Buses:
 - a. Material:
 - 1) Tin-plated aluminum.
 - a) Hard-drawn copper, 98 percent conductivity, may be substituted if provided at no additional cost.
 - b. Size: Ampacity as indicated on drawings, with uniform capacity for entire length of panelboard's sections.
 - 1) Neutral bus: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus
 - 2. Ground Bus: Equipped with connectors for feeder and branch-circuit ground conductors. For busway feeders, extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.
 - a. Material: Hard-drawn copper, 98 percent conductivity
 - b. Size: Minimum-size required by UL 67
- E. Line-Side Conductor Connectors (Lugs):
 - 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Material: Same as bus material.
 - 3. Capacity rating: Same as associated bus.
 - 4. Type: Provide mechanical type unless otherwise indicated on Drawings, refer to schedules and one-line diagram.
- F. Feed-Through Lugs:
 - 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Location: Locate at opposite end of bus from line side lugs or main device.
 - 3. Material: Same as line side conductor connectors.
 - 4. Capacity rating: Same as associated bus.
 - 5. Type: Same as line side conductor connectors.
- G. Subfeed lugs (Double Lugs):
 - 1. General: Suitable for use with conductor material and sizes. Connections shall comply with requirements of Division 26 Section "Low-Voltage Electrical Power Conductors and Cables".
 - 2. Location: Locate at same end of bus as incoming lugs or main device.
 - 3. Material: Same as line side conductor connectors.
 - 4. Capacity rating: Same as associated bus.
 - 5. Type: Same as line side conductor connectors.
- H. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and overcurrent protective devices.

- I. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- J. Panelboard Short-Circuit Current Rating – Fully Rated: Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. See manufacturers above.
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.
- D. Mains: As indicated on drawings.
- E. Branch Overcurrent Protective Devices:
 - 1. Connection to bus:
 - a. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - b. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
 - 2. Type: Provide types as indicated on drawings and as defined below.

2.3 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. See manufacturers above.
- B. Arc Flash Mitigation
 - 1. Overcurrent devices, 1200 A and larger, shall be provided with an energy-reducing active arc flash mitigation capability. The energy-reducing active arc flash mitigation system shall allow the operator to enable a maintenance mode using a switch which enables a preset accelerated instantaneous override trip to reduce arc flash energy. An LED on the trip unit shall indicate the trip unit is in the maintenance mode.
- C. 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. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 - 3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long- and short-time time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t 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 two-pole configurations with Class A ground-fault protection (6-mA trip).
 - 6. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
 - 7. Molded-Case Circuit-Breaker (MCCB) Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.

- b. Lugs: Mechanical type unless otherwise indicated on Drawings, suitable for number, size, trip ratings, and conductor materials.
 - 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: Relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - 1) Mounting: Integral
 - e. Multipole units enclosed in a single housing or factory assembled to operate as a single unit.
 - f. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in off position.
 - g. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- D. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- E. Fuses are specified in Division 26 Section "Fuses."
- 2.4 SURGE PROTECTION DEVICES
- A. Provide surge protective devices as required by Division 26 Section "Surge Protective Devices".
 - B. Panelboards requiring SPD and the location of the devices shall be as indicated on the Drawings.
- 2.5 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. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Wall-Mounted Panelboards: Install panelboards 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 panelboards not at walls, provide freestanding racks complying with Division 26 Section "Hangers and Supports for Electrical Systems."
- C. Mount top of trim 72 inches (1788 mm) above finished floor unless otherwise indicated.
- D. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- E. Install overcurrent protective devices and controllers not already factory installed.
- F. Install filler plates in unused spaces.
- G. Stub four 1-inch (27-GRC) empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch (27-GRC) empty conduits into raised floor space or below slab not on grade.
- H. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

- I. Comply with NECA 1.

3.3 IDENTIFICATION

- A. General: Provide identification complying with requirements specified in Division 26 Section "Identification for Electrical Systems."
- B. Panelboard Nameplates: Label each panelboard with a nameplate.
- C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate.
- D. Warning Labels: Label each panelboard with a warning label in accordance with NFPA 70 and NFPA 70E.
 - 1. Exception: Do not install NFPA 70 working clearance requirements on flush panelboards and similar equipment in finished spaces.
- E. Identify field-installed conductors, interconnecting wiring, and components; complying with Division 26 Section "Identification for Electrical Systems."
- F. Panel Directories
 - 1. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
 - 2. Note the date the directory was created/updated.
 - 3. Create directory after loads have been balanced.
 - 4. Replace existing directories with revised type written directories indicating changes.

3.4 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. 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.
- D. Panelboards will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Receptacles: Single, duplex, ground-fault circuit interrupters (GFCI), and tamper resistant (TR).
 - 2. AC Wall Switches: Single- and double-pole, three- and four-way, maintained and momentary.
 - 3. Device Wall Plates.

1.2 DEFINITIONS

- A. GFCI: Ground-fault circuit interrupter.
- B. TR: Tamper Resistant

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Division 01 and Division 26 Section "General Electrical Requirements".
- B. Product data for the following products:
 - 1. Provide manufacturer's catalog information specifically marked to indicate which devices are being furnished, and showing dimensions, colors, and configurations for all devices, including, but not limited to: Receptacles, AC wall switches, cover plates, and multi-outlet assemblies.
- C. Shop drawings for:
 - 1. List of legends and description of materials and process used for pre-marking wall plates.
- D. Field quality-control test reports.
- E. Operations and Maintenance Data:

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of wiring device and associated cover plate from a single manufacturer and through one source. Where practical and possible, obtain all wiring devices and associated cover plates from a single manufacturer and one source.
- B. Materials shall be manufactured by companies that have been specializing in the products specified in this Section, for a minimum of 10 years.
- C. Electrical Components, Devices, and Accessories:
 - 1. Listed and labeled as defined in NFPA 70, Article 100, by an NRTL as defined by OSHA in 29 CFR 1910.7, and that are acceptable to authorities having jurisdiction.
 - 2. Marked for intended use.
- D. Comply with NFPA 70.

1.5 COORDINATION

- A. Receptacles for Equipment Furnished by Owner or Under Other Divisions or Contracts: Match plug configurations.

1.6 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. Wall Plates: One for every 10 of each type (i.e., style, size, and finish) installed, but no fewer than two of each type.

PART 2 - PRODUCTS AND MATERIALS

2.1 GENERAL

- A. Wiring devices are defined as single discrete units of electrical distribution systems, such as convenience receptacles, switches, special purpose receptacles, and similar, which are intended to carry, but not use electrical energy. Install wiring devices as required by the Specifications and where indicated on the Drawings.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Receptacles and Switches:
 - a. Cooper Wiring Devices.
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Mfg. Company Inc.
 - d. Pass & Seymour/Legrand; Wiring Devices Div.
- B. In other Part 2 articles below, where lists of manufacturers and device catalog numbers are included, the following additional requirements apply to product selection:
 - 1. Additional Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include manufacturers listed in individual articles below, in addition to those listed in Paragraph "Manufacturers" above.

2.3 FINISHES

- A. Color:
 - 1. Wiring devices connected to normal power systems: Match existing devices, unless otherwise indicated or required by NFPA 70. Cover plates: stainless steel.
- B. Manufacturer's model numbers listed are to establish the quality of the wiring devices. Coordinate the proper suffixes in order to provide the correct color as specified above.

2.4 CONVENIENCE RECEPTACLES:

- A. The catalog numbers listed below are generally for 20A rated devices. Where 15A rated devices are indicated on the Drawings or required for circuit rating limitations, provide receptacles equivalent to those specified for 20A, but rated for 15A.
- B. Duplex convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

<u>Manufacturer</u>	<u>Duplex</u>
Cooper	CR20
Hubbell	BR20
Leviton	CR20
Pass & Seymour	CR20

- C. Duplex tamper resistant convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

<u>Manufacturer</u>	<u>Duplex</u>
Cooper	TRCR20
Hubbell	BR20TR

Leviton TBR20

Pass & Seymour TR20

- D. Duplex weather resistant convenience receptacles: Commercial Specification grade, NEMA 5-20R, 125V, 20A, grounding type, UL listed and labeled, smooth nylon face, side and back wired, self-grounding.

Manufacturer Duplex

Cooper WRBR20

Hubbell 5362WR

Leviton WBR20

Pass & Seymour WR20TRW

2.5 GFCI RECEPTACLES

- A. Ground fault circuit interrupter type receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

Manufacturer Specification Grade

Cooper VGF2

Hubbell GF20LA

Leviton T7899-H

Pass & Seymour 2095

- B. Ground fault circuit interrupter type weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

Manufacturer Specification Grade

Cooper WRVGF20

Hubbell GFTR20

Leviton W7899

Pass & Seymour 2095TRWR

- C. Ground fault circuit interrupter type tamper and weather-resistant receptacles: Specification Grade UL listed and labeled complying with UL 943, Class A and NEMA WD-1-1.10, 125V, 20A, trip at 4-6mA within 0.025 second, and feed-thru type with integral heavy duty NEMA 5-20R receptacle arranged to protect receptacles down stream on the same circuit.

Manufacturer Specification Grade

Cooper	TWRVGF20
Hubbell	GFTR20
Leviton	W7899-T
Pass & Seymour	2095TRWR

2.6 COVER PLATES

- A. Damp Location Weatherproof Receptacle Cover Plates: UL-listed Wet Location (cover closed, not in use); die-cast, gasketed (factory-installed) self-closing covers, for horizontal mounting:

<u>Manufacturer</u>	<u>Horizontal</u>
Cooper	1966
Hubbell	RW51020
Leviton	4990
Pass & Seymour	4511

- A. Wet Location Weatherproof Receptacle Cover Plates (Outlet Box Hood): NEMA 3R weather resistant recessed or flush mount, die cast aluminum lockable cover. Configure cover for horizontal mounting of receptacle or as indicated otherwise. Back box must be suitable for conduit connections. Coordinate back box with wall depth.

<u>Manufacturer</u>	<u>Horizontal</u>
Thomas & Betts	CKMU
Eaton	WIUMV-1
Hubbell	WP26MH
Leviton	IUM1H-GY

- B. Damp and Wet Location Weatherproof switch cover plates: Fabricated of cast aluminum or cast zinc, sealed water-tight and UL listed for wet locations.

<u>Manufacturer</u>	<u>1 Gang</u>	<u>2 Gang</u>
Appleton	FSK	--
Raco	5100 Series	--
Steel City	SW Series	--

- C. Other locations: Single and combination types to match corresponding wiring devices and manufacturer of wiring devices specified herein.
 - 1. Plate securing screws: Metal with head color to match finish plate.
 - 2. Material for Finished Spaces: Brushed stainless steel Type 302.
 - 3. Material for Unfinished Spaces and surface mounted wiring devices: Galvanized steel.
 - 4. Masonry walls and oversized wall openings: Jumbo size plates with same material as indicated above.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install all wiring devices plumb, level, and square with building lines. Wiring device bodies shall extend to the finished surface of the walls, ceiling or floor, as applicable, without projecting beyond them.
- C. Connect wiring devices by wrapping conductors around screw terminals. 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.
- D. Connect wiring device grounding terminal to branch circuit equipment grounding conductor and bond to metal outlet box. Exception: Do not bond grounding terminals of isolated ground receptacles to the outlet box.
- E. Install devices shown on wood trim, cases or other fixtures symmetrically and, where necessary, set with the long dimensions of the plate horizontal, or ganged in tandem.
- F. Unless dimensioned otherwise, install wiring devices a minimum of 24 inches from the closest edge of any sink.
- G. Install switches with OFF position down.
- H. Install cover plates on all switches, receptacles, and blank outlets.
- I. Locate wiring devices so that the cover plate does not have to be cut to be installed.
- J. Where devices are shown near wall openings, coordinate location if corner guards are to be installed so that cover plates do not require cutting.
- K. Install cover plates after the wall has been finished (painted, wall paper, etc).
- L. Install device boxes in brick or block walls such that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
- M. Provide safety-type, tamper-resistant receptacles in all areas where receptacles are mounted less than 5'-6" AFF and are easily accessible to children.
- N. Provide ground fault circuit interruption capability for all 120V receptacles 50A or less and all 208/240V receptacles 100A or less in code required locations. Locations include, but are not limited to: bathrooms, kitchens/food prep areas, exterior locations and within 6' of sinks. Interruption capability can be achieved via a GFCI circuit breaker or a GFCI receptacle.
- O. Provide type and quantity of normally open and/or normally closed contacts for emergency off buttons to meet the sequence of operations shown.
- P. Install wiring devices shown back-to-back on a common wall offset a minimum of 12" horizontally to reduce sound transmission between rooms.

3.2 GENERAL

- A. Outlets are only approximately located on the small scale Drawings. Use great care in the actual location by consulting the various large scale detailed Drawings used by other Division trades, and by securing definite locations from the owner.
- B. Do not use multi-conductor circuits, with a shared neutral, for any GFCI receptacle circuit. Provide a separate neutral conductor with all GFCI receptacle circuits.
- C. Provide twist-locking type receptacles or other special type receptacles where indicated on the Drawings.

3.3 EXAMINATION

- A. Verify existing conditions prior to beginning work.
- B. Verify that outlet boxes are installed at proper height and are flush with the finished surface.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.4 PREPARATION

- A. If required, provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean debris from in and around outlet boxes.

3.5 MOUNTING HEIGHTS

- A. Coordinate locations of outlet boxes provided under Division 26 Section "Common Work Results for Electrical".
- B. Unless noted otherwise, install wiring devices at mounting heights indicated in the Electrical Symbols Legend on the construction drawings.
 - 1. Receptacles:
 - a. General:
 - 1) Unless indicated otherwise, install vertically with the ground slot mounted at the top.
 - 2) Where Installed horizontally, install neutral slot mounted at the top.
 - b. Above counters:
 - 1) Mount vertically.
 - c. Mechanical and electrical equipment rooms and janitors closets:
 - 1) Mount horizontally.
 - d. Weatherproof exterior receptacles:
 - 1) Mount horizontally.
 - e. GFCI receptacles: Same as general receptacles.
 - f. Concrete Block Walls: Dimensions above may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom or top of boxes, as applicable, are at block joints.
 - 2. Switches:
 - a. Above counters: Same as for receptacles.
 - b. Concrete Block Walls: Dimension may be adjusted slightly, as required to compensate for variable joint dimensions, such that bottom of boxes are at block joints.
 - c. Walls with wainscoting: 6 inches minimum above wainscoting, but not exceeding 48 inches above finished floor.

3.6 IDENTIFICATION

- A. Label all devices fed down stream of GFCI protected receptacles as "GFCI PROTECTED".

- B. Comply with Division 26 Section "Identification for Electrical Systems."
 - 1. Receptacles and Switches: Identify panelboard and circuit number from which served, using:
 - a. Adhesive Film Label with Clear Protective Overlay, but with letter/number height of 1/4 inch, on face of plate.

3.7 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
- D. Test all wiring devices for electrical continuity and proper polarity of connections.
- E. Test each GFCI receptacle device for proper operation.
- F. Correct wiring devices incorrectly installed.
- G. Repair or replace all damaged items or damaged finishes at no expense to the Owner.

3.8 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.9 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.

1.2 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.3 SUBMITTALS

- A. Product Data: For each type of enclosed switch 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).
- 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.
- C. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.
- 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.

1.5 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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
 - 2. Altitude: Not exceeding 6600 feet (2010 m).
- 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 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.

1.6 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.

1.7 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. 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.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
 2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
 3. Siemens Energy & Automation, Inc.
 4. Square D; a brand of Schneider Electric.
- B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified 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. Lugs: Mechanical type, suitable for number, size, and conductor material.
 5. Service-Rated Switches: Labeled for use as service equipment.

2.2 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.

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. Install fuses in fusible devices.
- C. Comply with NECA 1.

3.3 IDENTIFICATION

- A. Comply with requirements in Division 26 Section "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. Perform tests and inspections.
- B. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each enclosed switch, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- C. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- E. 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.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION 262816